AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

VOLUME 20. NEW YORK, THURSDAY, JUNE 10, 1897. NUMBER 23.

American and Other Machinery Abroad—V.

[Editorial Correspondence.]

WOOLWICH ARSENAL.

Most Americans interested in mechanical matters have heard a good deal of Woolwich arsenal and think that when they come over here they would like to visit it, and that there is little or nothing to prevent their doing so—no more than there is to prevent foreigners from visiting our armory at Springfield. Perhaps, therefore my experience in not visiting Woolwich will be useful to some of my fellow countrymen, and on that account worth recording. I was informed that though it was a simple matter for a British subject to see the arsenal, somewhat more formality must be gone through with in the case of a foreigner, and that it would be necessary for me to make application through the American Embassy. I applied there and was informed that before they could act they must have a letter from someone whom they knew here, certifying to my American citizenship, and also to the fact of my being a proper person to see the arsenal. I must get this letter and present it at the Embassy in person. My passport, obtained with a visit to Russia in view, would not answer. In due time I obtained and presented the letter, and was then assured that there was little or no doubt of the application being favorably acted upon. It had to go through the War Office and several other ordeals of inspection which would require some little time, but in view of my desire to get away from London soon a special request would be made to accelerate its movements a little. The Easter holidays and the grip kept me in London much longer than I had designed to stay there, but not long enough for the machinery of the War Office, etc., to act. At the end of about two and a half weeks, nothing having been heard of the matter I was forced to abandon the project of seeing the famous gun factory, and do not now know whether it was a case of refusal of the application or of the doings of the circumlocution office. At any rate an American who realizes that he has only one life to live had better take some other plan, though I am at a loss what other to suggest.

STRENGTH FIRST AND LAST.

I asked an American engineer, long a resident here, what this extending use of American tools here really meant, at present and for the future, and he said: "It means simply that those who use tools here are discovering that there are other things to be considered in a tool besides mere strength." It is nevertheless a fact that the British determination to have everything strong enough, and then stronger still, works well in some lines. For instance, I think there is no doubt but that it leads to generally better boiler practice than our own; but, on the other hand, in the matter of Corliss valve gear it does harm; they make the parts so heavy usually that they bang themselves to pieces much quicker than our Corliss gears do, and soon grow noisy. Then the difficulty is sometimes declared to be inherent in that form of gear, which is, after all, "a Yankee contraption," notwithstanding its merits as a means of steam distribution. In other lines also I notice this tendency to consider strength first and last, and to let it overshadow every other consideration is detrimental. For instance, I went through a very large new factory making bicycle parts, and where a great deal of light vise work is, of course, done. There were none of our light and quickly handled parallel vises in the place; all were the old-fashioned wrought vises with legs reaching to the floor, and the gage department of the most famous institution in England uses the same vises. They do not break, it is true; but neither would our parallel vises break on such work, and it is certain they would very materially increase the possible production of work, especially in filing and otherwise finishing bicycle parts. Of course, I do not mean to imply that no parallel, quick-acting vises are used here, because they are; but we use them to the practical exclusion of every other kind of vise on light work, which is by no means the case here.

COVENTRY THE BICYCLE CENTER.

Coventry, the greatest cycle manufacturing center of the world, is naturally an interesting place from a mechanical standpoint, and very much American machinery is used there, some of it being in factories intended for the production of motor vehicles; which seem likely to be also a distinctive product of the place. The cycle industry has in fact outgrown the town, and I met an American doing business there who, with his wife is stopping at a hotel in Birmingham, 20 miles away, because he finds it impossible to secure a house in Coventry, and the hotels there absolutely refuse to let apartments by the week at any price, because the present boom is regarded as probably temporary and they do not wish to be placed in the position of being unable to accommodate travelers who are more or less regular patrons. There are said to be 10 large and about 20 smaller factories there, besides innumerable garret and back yard shops where parts are made or wheels put together. The capital invested in the industry is estimated to exceed $500,000,000, and in the regular factories of importance, not counting the tributary ones, 26,000 to 28,000 employés are at work. These are described by an American, who has had exceptional opportunities of observing them, as being very different from the corresponding class of workmen in America, and he says this is the best illustrated perhaps by the fact that this city of over 60,000 population supports only one daily newspaper, the circulation of which is not much, if any above 1,000 copies. Of course this is not saying that there are no good, skilled and intelligent mechanics there, however, for there are some of these to my personal knowledge; they do elegant work and get good prices for it, quotations for the higher grades of cycles ranging somewhat higher than with us, and in some instances considerably higher. So long as cycles were radically changed in style and construction every season, their methods of producing them had advantages over ours, notably in the smaller outlay for special tools. It was then that English wheels went to America in large numbers. But now that wheels have in a measure settled down to a regular form, and are made in larger numbers all alike, the advantage is with us, and the large use of our machinery and tools then seems to show that this fact is coming to be clearly recognized.

A Coventry maker of a special high class cycle, a man who has been in America, showed me some of the drop forgings which he said he was obliged to put up with, as they were as good as any pro-

duced in England. I really do not believe any user of drop forgings in America would think of accepting them, for they were simply vile, or at least would be considered so from our standpoint—simply indescribably rough and misshapen—as though the dies for making them had been "made with an axe," and if such forgings are generally used, they must add very materially to the cost of wheels.

Among the English tool builders who have been kept busy largely by this demand from the cycle factories is Alfred Herbert, whose works are in Coventry, and who is at present constructing large additions to them, which will give him a total of 60,000 square feet of shop floor, all on one level and covered by a saw-tooth roof. Very many American tools are at work in this place, among them five universal grinders; his works manager being fully cognizant of the fact, not always as well understood as it might be in our own shops, that this affords a cheaper as well as a better method of finishing work to size. A practice of theirs which I do not feel so certain about is that of fitting such slides as those for turrets, by grinding on a surface grinder, no scraping or other subsequent fitting being considered necessary. This, it is declared, can be satisfactorily done by only one make of emery-wheel, however (English), and they say the wheel is useless for other (cylindrical) grinding.

The method generally followed by us of making standard tools and manufacturing them in lots is followed here to a considerable extent, and other evidences of the influence of distinctively American practice are to be seen. Oscar Harmer, an American who has been located here for some time, is connected with the establishment in an executive and advisory capacity, and in discussing matters with him, he said one cause of frequent trouble with American tools here was with their countershafts, which were apt to be too light and to be supported in hangers also too light. He said a Bristol tool builder would, for instance, always key the tight pulley on a countershaft, while an American would hold it with a set-screw, and these set-screws would often not hold; which is to me a new source of difficulty, and one which I never encountered or heard of at home.

THE NEW WILLANS & ROBINSON SHOPS.

Not long since I visited, in Chicago, the shop of M. C. Bullock, who builds the Willans engine for American trade. Almost nothing was being done—short force and short time. At Rugby, twenty miles south of Birmingham (where Tom Brown went to school and afterward wrote a famous book about it), I visited a few days ago, the new shop of Willans & Robinson, who build the same engine for the European trade. The strong contrast between the two shops, as regards the condition of business, illustrates quite vividly the general difference in the business situation between the two countries. The Rugby shops are very large, and the works are not yet fully moved from Thames-Ditton; yet already, before being fully occupied, they are constructing an addition made necessary by a failure to fully anticipate recent growth of business. Fortunately, like the De La Val Shops at Poughkeepsie, which we illustrated some time ago, the Rugby shops are specially designed to be enlarged as occasion demands.

I am inclined to think that these Rugby shops are, all things considered, the best I have ever seen anywhere. There has been room enough and money enough to make them right, and they have been planned in the light of experience in manufacturing the specific thing to be produced. I am promised photographs and full particulars regarding the establishment, and so need not say anything further at this time about it. They are, architecturally, pleasing in appearance, have saw-tooth roofs and cranes and "tram-ways" galore; things being so arranged that pig iron and other raw material deposited at one end of the plant moves in one direction only until it emerges at the other end in the form of finished engines, which are manufactured strictly upon the interchangeable plan flatteringly referred to as "American," though I confess I do not know of an American shop building engines which carries the principle quite so far.

They have had in use here for some time a plan of premium paying, very similar to that proposed by our Mr. Halsey in his paper read at the Providence meeting of the American Society of Mechanical Engineers, and are much pleased with its results, and declare that they secure an *esprit de corps* quite unusual here. They are erecting a messroom for the men, and expect to put up what will be called an Institute for them within the grounds. Good results are reported from these efforts in behalf of the men, notwithstanding the fact that an English engineer of experience had previously assured me that all such efforts to introduce the amenities into shop life here were foredoomed to failure; that the men did not understand nor appreciate them, and would make anyone who tried such things thoroughly disgusted with the results. In fact, I was told at Willans & Robinson's that the English workman was "a jolly rum chap," and that occasionally he would give one a back-set that would be decidedly disconcerting or even disgusting, but nevertheless they persisted, with very satisfactory general results.

TANGYE'S.

The famous Tangye establishment in Birmingham proved of course an interesting place to visit, and I found it to be, as one might say, in the act of taking one of those steps forward which mark the progress of every concern that long remains in the forefront of industrial activity. A good deal of re-designing is being done, especially in their tool building department, which is under the immediate management of Mr. John Tangye, and here in this work clear traces of American influence are to be discerned—candidly credited to their source. There is no slavish copying, and the designs are in the main still distinctly British, but American ideas are incorporated where it is thought they are suitable to conditions here.

Mr. John Tangye is one of those who do not admire the gap feature in lathes, but he says they are obliged to build a good many with gaps because customers will have them. In their new designs they have entirely abandoned the use of cast gears and will use cut gears exclusively, thus forsaking one of the landmarks of English tool construction, adhered to generally here long after our practice had shown that with automatic gear cutting machines, cut gears are produced ready for use at about the same or lower cost, and that a saving is effected by reason of the fact that center distances can be predetermined and holes bored with a certainty that cut gears will run properly and require no fussing with.

A LARGE GAS ENGINE.

Here I was strongly reminded of the fact that gas engines have made far more progress in this country than with us, by seeing a very busy department devoted to their production and at present turning out 70 to 80 engines per month; this shop capacity being, however, insufficient to supply the demand. On the testing floor was a gas engine running (built for the Swindon shops of the Great Western Railway), with a cylinder 27 x 33 inches, designed to run at 130 turns, and to develop 250 brake horse-power with city gas or 180 with producer gas. This engine complete weighed about 28 English tons and to American eyes looked a veritable monster. Such engines, I was informed, had been operated under the best conditions on a consumption of .75 pound of coal per hour brake horse-power and would regularly run at less than one pound with producer gas.

SOME WATT RELICS.

In the Board room at Tangye's are a lot of drawings, models, etc., which are examples of the handiwork of James Watt. Some of the drawings are of his earlier and some of his later engines, and there is also a steam engine indicator made by him, and which is certainly one of the first and perhaps the first instrument of the kind ever made. It boasts of no parallel motion, but instead the pencil is attached directly to the upper end of the piston which is extended upwards from the indicator cylinder and provided with a socket for that purpose.

Here also is the chair used by Watt in

his office at the Soho works and beside it, perserved with apparently equal care, are two others which were occupied by the Duchess of some-thing-or-other and her daughter on the occasion of their visit to the Soho works, the fame of which became so great as to attract visitors of the highest rank from all parts of the world.

THE RAILWAY SHOPS AT CREWE.

On the way from Birmingham to Manchester I stopped over several hours at Crewe and visited the famous shops of the London & Northwestern Railway, where they have about 3,000 locomotives to maintain and replace, and employ about 7,500 men; the total number of employés in the locomotive department of the road and working under the direction of Mr. Webb, chief mechanical engineer, being about 19,000.

Practically everything required by the road is made here, from the raw materials. They make their own steel—Seimens and Bessemer—roll their own rails and bar iron, cut their own files, both hand and machine cut, make their own twist drills, having two special machines for grooving them, and finally have two men who are specialists and who devote their time to making artificial legs and arms for employés who have lost their natural ones by accident.

There are 40 acres of shops and here the first Bessemer steel rails were rolled. They roll their own tires from the ingots, which are cast by themselves and a somewhat similar job is that of rolling a ring with a groove in one side of it which is then cut while hot into segments which form the links for the Joy valve gear.

The practice of making interchangeable parts for locomotives, so far as possible is adhered to, and there are many magnificent tools for the heavy work of both boiler and machine construction—tools which would be possible only where things are done upon a large scale and with plenty of capital available. Speaking broadly the works are wonderful and admirable, but there are here and there points of detail which, as is usually the case with such large establishments would seem to leave room for a fair profit, for a manufacturer making a specialty of the things produced. I have seen twist drills being made in two leading American factories, and feel quite certain that in those factories they are produced very much cheaper than at Crewe, and probably much cheaper than they ever can be produced there. It is probable, however, that Mr. Webb also is well aware of this and that there is some special reason for preferring to make them. One thing which stands in the way of high productive capacity on such work, and on turret machine work as well, is the fact that water or some mixture of water and soap and oil is used instead of lard oil, which we think necessary for efficient work in milling tool steel, and this difference in practice appears to be general as between the two countries.

I saw a boy here turning small taper pins with a hand actuated slide rest. He was making them as a regular thing and said he made 150 a day. A man was making hot pressed nuts with a special and very efficient machine. He was doing his own heating and walking back and forth between machine and furnace, a distance of about 10 feet; the machine standing idle while he walked and arranged the bars in the furnace. Such nuts were being finished by a planing operation, the machine used for this being a special one having six arbors arranged side by side and geared together so as to be indexed (by hand) simultaneously. Six planing tools on six saddles did the planing and each arbor held about 12 inches of one inch nuts. One cannot tell in merely walking through such an establishment, especially in a foreign country, where conditions often are entirely different from those at home, what reasons there may be for doing things in a certain way and not doing them in another, and it would be presumtuous in me to criticize these operations, but I need only describe them as I have done to show how much they differ from our own best practice.

In heavy milling they do very well indeed, and their boiler practice is admirable. Mr. Webb is decidedly progressive and does many things in advance of general practice. He was one of the earliest users of steel in boiler construction, and informed me he had never had a failure of a steel boiler plate. His well-known type of compound engine, one of which was operated for some time on our Pennsylvania Railroad is extensively used in express service and is known to give excellent results in point of economy of coal and for repairs.

Here I was shown the engine "Greater Britain," resplendent in red paint and gold leaf and bearing the Queen's coat-of-arms, ready for service in pulling the royal train during the coming Queen's Jubilee. An engine just like the "Greater Britain" was exhibited by the road at Chicago.

F. J. M.

Manchester, May 14th.

▲ ▲ ▲

Hydraulic Flanging Machine.

Through the courtesy of the Schenectady Locomotive Works we are enabled to present herewith views showing the appearance and method of operation of what is probably the most highly organized specimen of hydraulic flanging machinery ever constructed. In general, hydraulic machinery for all classes of forge work has been developed further and is in much more general use in England than here, machines upon the general principles of this one being comparatively common there. At the same time this individual machine, both in its magnitude and in the completeness of its arrangement of auxiliary rams, is believed to surpass anything which has been made either there or here. The human figures included in the first picture will give at once an idea of the size of the machine; in fact, the picture gives, in some respects, a better idea of its magnitude and arrangement than does the machine itself, as when set up for use, it is sunk in a pit to the depth of the position of rest of the platen which forms the heavy middle horizontal casting, so that a large portion of the machine is out of sight. The main columns are 27 feet long, and the platen is 10 feet 3 inches wide by 14 feet long. The arrangement of the rams is as follows:

First, the main ram of 28 inches diameter, the cylinder for which is carried by the bottom horizontal bed piece and the ram of which carries the middle platen, which thus rises and falls as the flanging is done.

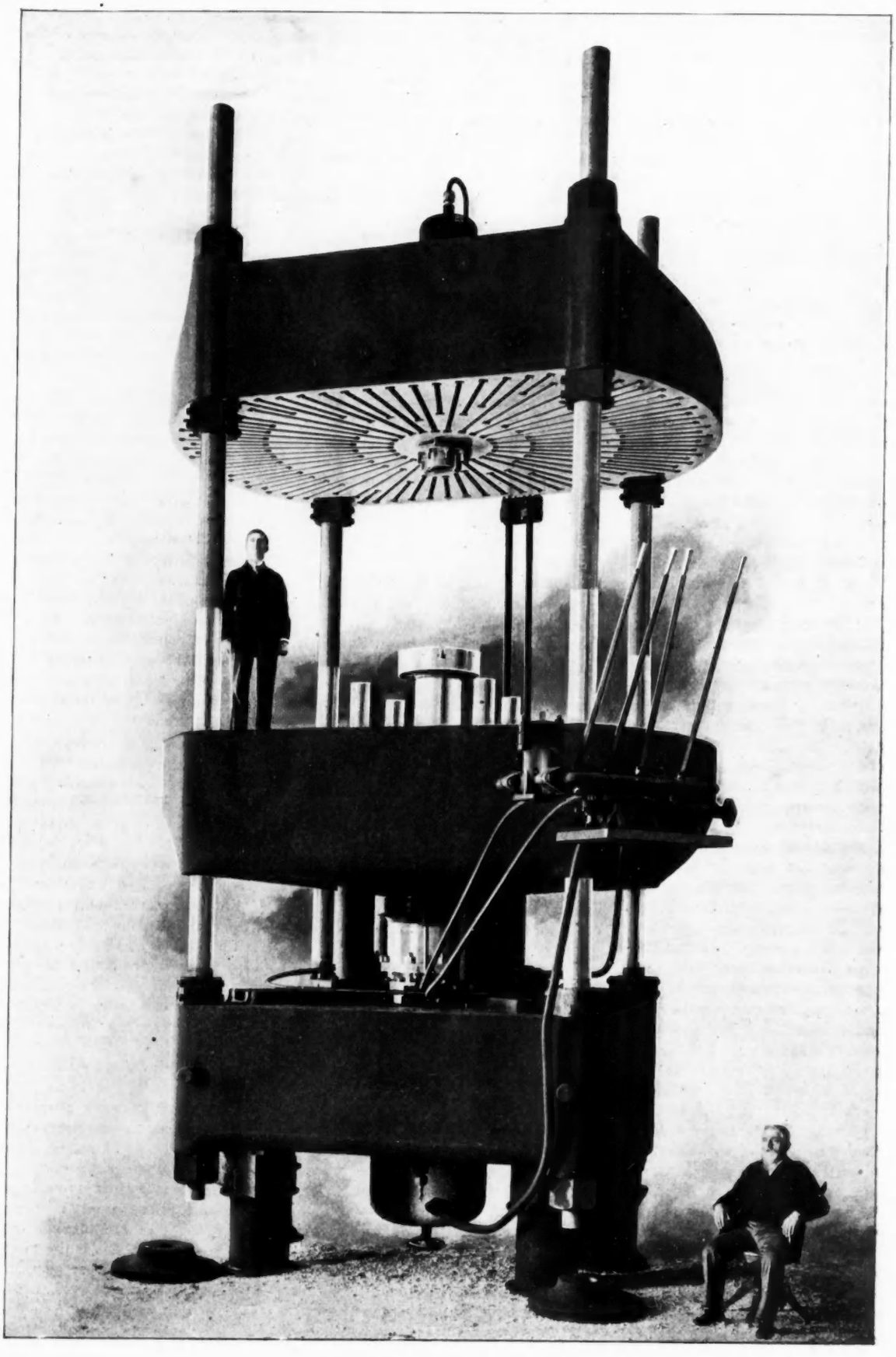
Second, a returning ram of 10 inches diameter, which is carried by the upper inverted bed-piece, and the cylinder for which will be seen projecting above that casting, while the ram will be seen projecting through the lower face, held up in the photograph by a strap. This ram is a differential piston ram, the lower or annular surface of the piston being used for the return or upward stroke, while the full size of the piston is used for the acting or downward stroke. Of course when water is connected to the machine the ram is held in position by it—the strap mentioned being used when the picture was taken as the water connections had not been made.

Third, a holding or vise ram of 14 inches diameter, the cylinder of which is carried in the center of the moving platen, being in fact the piston of the main ram. The water supply of these rams is, however, independent. The T-slotted head of this vise ram will be seen projecting up through the platen in the first view.

Fourth, an arrangement of four smaller vise rams of 6 inches diameter each, set at the corners of a square, and which will also be seen projecting up through the platen. The cylinders of these rams are carried by the lower bed plate, and the rams are entirely independent of the platen.

The purpose of the returning ram upon the upper bed plate is to push the die back out of the work after the flanging is completed, as is necessary in some cases, such as the saddle-shaped piece called the dome connection. The purpose of the vice rams is to clamp the sheet in position and hold it there rigidly while the dies are turning the flanges. While, however, this is the main purpose of these rams, they are also, in some of the smaller pieces of work, used for turning the flanges.

There are two general systems of dies employed in connection with this press. The first is used when flanging a simple boiler head in which the flange is turned upon the outside of a disk, while the sec-



HYDRAULIC FLANGING PRESS.

ond is seen in such cases as dome connections, where the flange is turned upon the inside of a ring. The first class is illustrated in Fig. 2, which shows the dies employed for the front head of a locomotive. The form of the dies will be seen from the illustrations. The lower or ring die has at the top a recess into which the hot sheet of metal is dropped. Water is then turned on to the vise ram, when it and the clamping plate rise and pick up the sheet and clamp it solidly against the upper die, in which position the sketch shows the parts. Water is then turned on the main ram, when the platen and ring die rise and turn the flange in less time than it takes to tell it. The returning ram will be seen partly concealed by one of the inverted legs supporting the upper die, but it is not used in connection with this piece of work.

The method of operation in flanging the dome connection will be seen in Fig. 3. The flanging die is here a plug carried by a stand which rests upon the platen. This plug has a turned neck at its top which centers the piece to be flanged. After the piece is laid upon this die, the water is turned on the four outside vise rams, causing the lower clamping die to rise, thereby bending the sheet to the curve of the boiler shell and clamping it in position for flanging, when the water is turned on the main ram, causing the platen and central die to rise and flange the work, which will be seen in the illustration with this operation just completed. The water is then turned off of the main ram and on the returning ram, when the latter forces the die back through the flanged piece.

These dome connections are made of 1-inch plate, and form the heaviest piece of flanging done on the machine, although one of the simplest, so far as mechanical difficulties go.

Some of the shapes which are made with this machine will be seen in Fig. 4, from which an idea of the great usefulness of such a press in a locomotive works will be apparent. The character of the work when finished is such as to delight a mechanic's eye, and it not only looks better, but is better than work done by hand, especially because it is finished hot, and is not hammered and strained by pounding when in a half-cold condition. It is also, of course, truer to the intended dimensions than hand work can be.

The operating levers which control the water valves will be seen attached to a plate alongside the press. In the illustration this plate is supported by the pipes, but as erected in the shop, the plate is bolted to a cast-iron floor plate which surrounds the machine. The sheets for the press are heated in an oil-fired furnace.

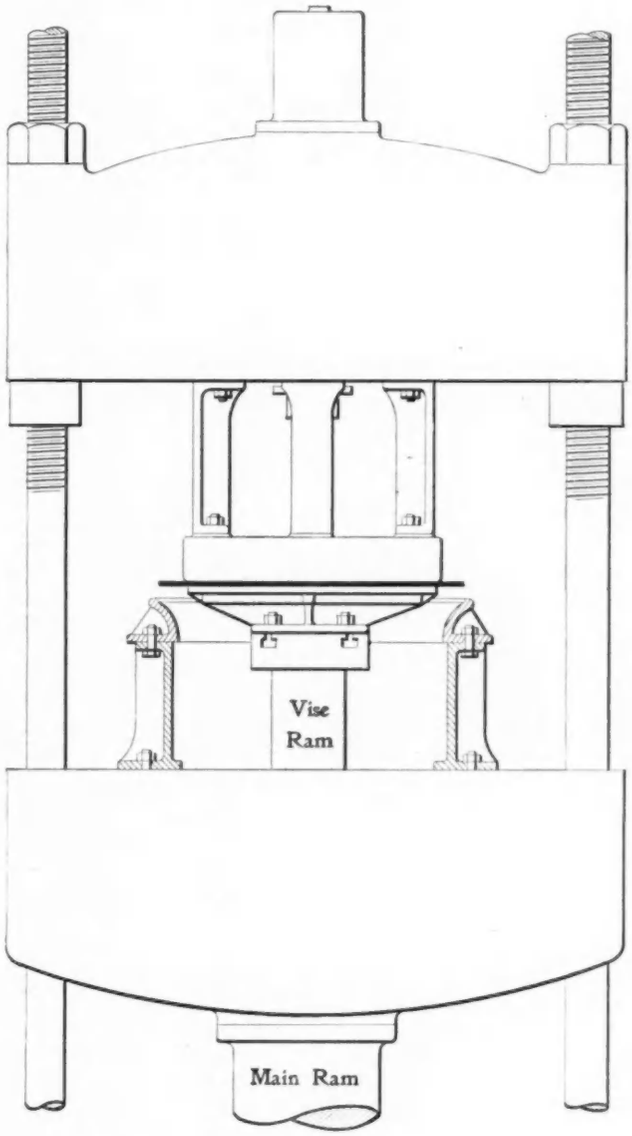


Fig. 2
TURNING THE FLANGE OF A FRONT TUBE SHEET.

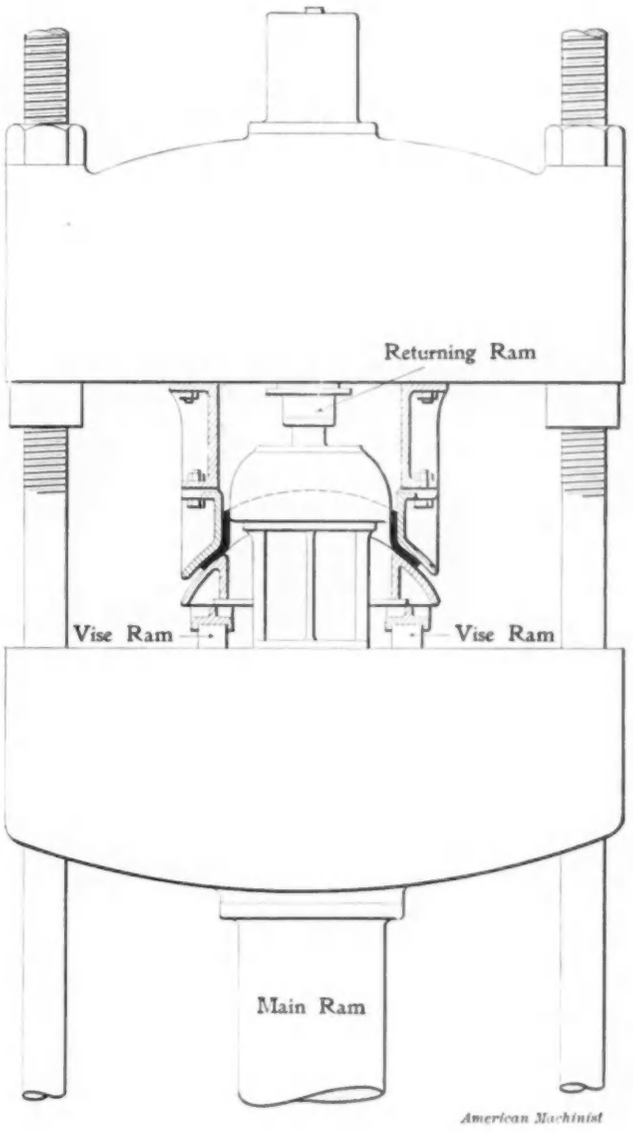


Fig. 3
TURNING THE FLANGE OF A DOME CONNECTION.

Strength of Gear Teeth.

BY W. T. SEARS.

The tables of Wilfred Lewis for the strength of gear teeth that appeared in a paper read before the Engineers' Society of Philadelphia several years ago are so well known that any remarks in regard to them are probably unnecessary further than to give a few reasons why the trouble was taken to prepare the accompanying chart.

In the first place, they, doubtless, give the most correct results of any method in use at the present time, working out well in practice, giving a tooth that seldom breaks, and yet does not appear large and clumsy, as is apt to be the case with one worked out from an assumption that the load is all applied at the extreme outer corner.

They are not calculated for short teeth, but for the hight of those in general use by machine tool builders at the present time, and take account of the variation in strength due to alteration of shape from pinion to rack for teeth of the same pitch, and also make an allowance for the extra strength required at high speeds.

Referring to the chart:

The lines given are for sizes as taken from Mr. Lewis' tables, and give them all, with the exception of a few intermediate ones for numbers of teeth, and for teeth of 20 degrees involute and radial flanks, the chart being as noted for 15-degree involute and cycloidal.

The method of using is given on the chart, the following being an example:

Given a gear of 2-inch pitch, 6-inch face, 40 teeth and 50 revolutions per minute of cast iron, to find the strength.

Starting at the top of the chart at 6-inch face, follow vertically to intersection of angular line marked "2-inch pitch," then to diagonal line marked "pitch diameter times revolutions per minute equals 1,146" (this being practically correct), then vertically to line marked 38, or just below it, to be more accurate, for number of teeth, and in column of figures horizontally to the right is found 6,000, which is the working strength of the tooth in cast iron in pounds.

In case a small pitch and face are given, each or either can be multiplied by any numbers desired to bring sizes out to where the lines are clear enough to give accurate working, it then being necessary to divide the result by the product of the numbers used to get the correct answer. If the pitch and face are larger than the sizes given on the chart, then the foregoing method can be reversed—that is, divide them by such numbers as will bring them within the limits of chart, and multiply result by product of figures used.

The chart is also very useful when worked backwards, as, for instance, having given a shaft or pulley, to find the pitch and face of a gear of equal strength, and this by means of moments in connection with some of the charts that have lately appeared in this paper I have found of great value.

[It will be seen that Mr. Sears' diagram attacks the problem from a different standpoint from that of Mr. Hess, which appeared in our issue for February 18th. Some readers will doubtless prefer one, while others will prefer the other, and on this account we have thought it advisable to give both.—Ed.]

▲ ▲ ▲

High-Pressure Air Compressor and Receiver for the Hardie Locomotive.

Having shown in our issue of May 6th the Hardie compressed-air locomotive, which has now commenced running trains upon the Manhattan elevated railway in this city, we are now enabled to also present to our readers some views of the air compressor and the receiver or storage reservoir, which have the responsibility of providing and maintaining the supply of compressed air. The half-tones exhibit the facility and perfection of our modern means of illustration. The apparatus here illustrated is located in close quarters in a very dark building at 100 Greenwich street, New York, but very creditable photographs have been secured, and the half-tone process reproduces them for us very faithfully and clearly.

The air compressor was built by the Ingersoll-Sergeant Drill Company and designed by Mr. Henry C. Sergeant, of that company. No boiler plant is installed for driving the compressor, the steam being supplied by the New York Steam Heating Company, whose pipes ramify the lower section of the city where the compressor is situated. The compressor comprises first of all a complete duplex Corliss horizontal non-condensing steam engine, with steam cylinders 18 inches diameter by 36-inch stroke, running at a normal speed of 60 revolutions per minute. The lower view (Fig. 2), from the crank and fly-wheel end of the engine, shows nothing different from the usual steam engine of this type.

The upper view (Fig. 1) shows the air-compressing end of the machine. The air cylinders are submerged in the rectangular water boxes in the foreground, so that they are not visible. The piston rods are continued out through the back heads of the steam cylinders and into the air cylinders, where the air pistons, all single acting, are attached, two upon each rod. The diameters of the air cylinders are, successively, 21 inches, 9 inches, 7 inches and 3 inches; this peculiar series being

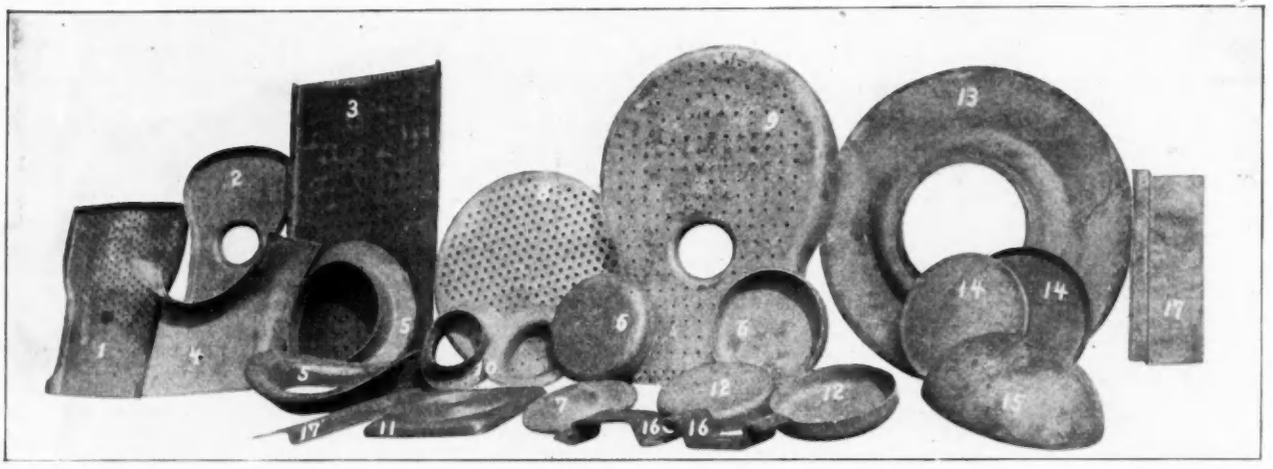


Fig. 4. SAMPLES OF WORK DONE ON FLANGING PRESS.

1. Fire Box Tube Sheet.
2. Fire Box Back Sheet.
3. Fire Box Crown Sheet.
5. Dome Connection.
6. Dome Ring.
7. Dome Cap.
8. Boiler Front Tube Sheet.
9. Boiler Back Head.
10. Smoke Stack Base.
11. Steam Chest Casing Top.
12. Cylinder Head Casing.
13. Boiler Front.
14. Boiler Front Door.
15. Dome Casing Top.
16. Brake Cylinder Support.
17. Deck Piece in Cab.

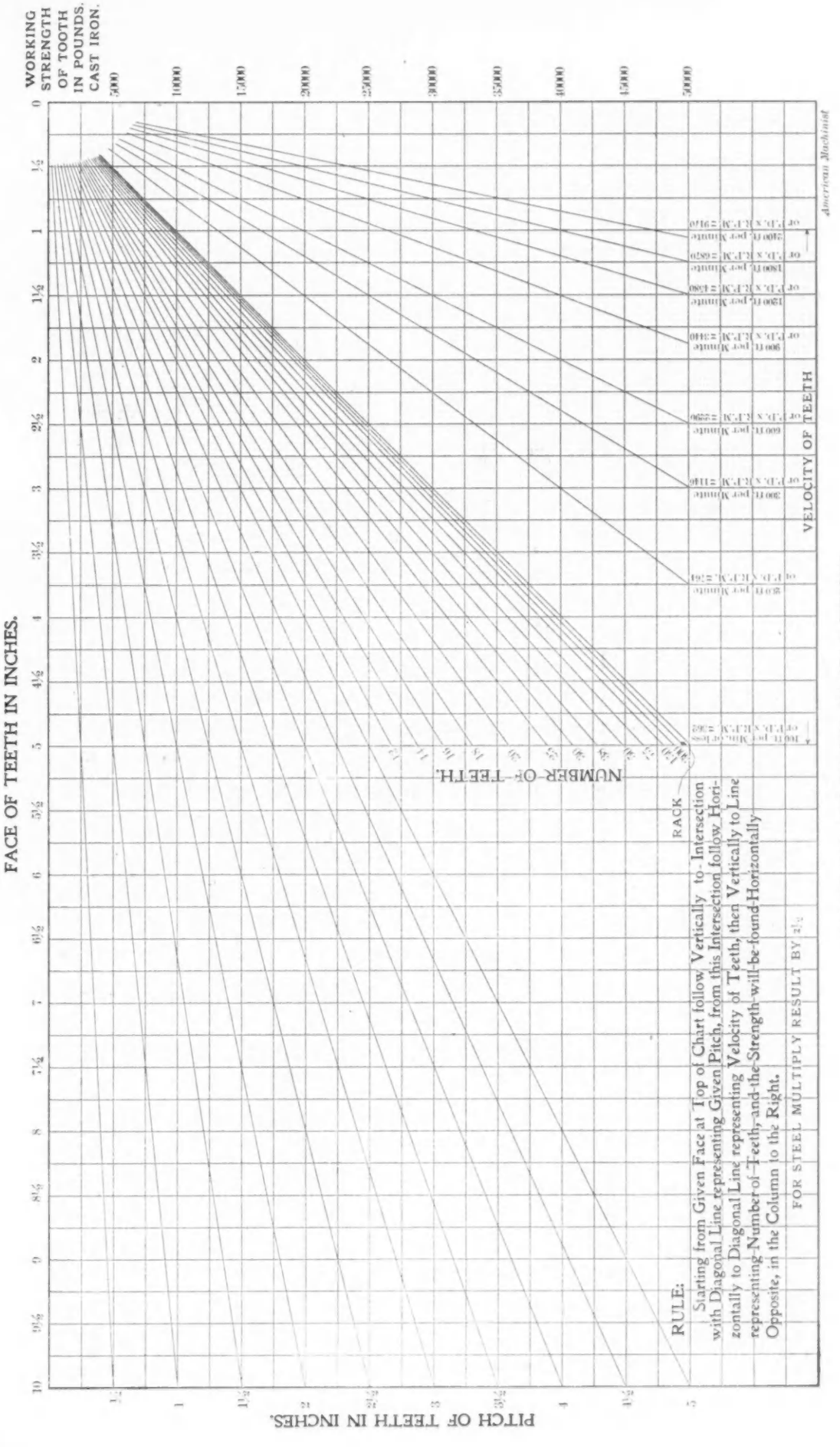


CHART FOR STRENGTH OF GEAR TEETH.

(15° Involute and Cycloidal)

adapted, it is said, to secure an equitable distribution of the work throughout the revolution. The diameter of the piston rods is 2¾ inches, and this is to be deducted from the working areas of the low pressure and the second intermediate cylinders. The piston-rod area (a half-inch larger diameter than the above for the crank end) is also to be deducted from the area of each end of each steam cylinder. The low-pressure and the first intermediate air cylinders are on the left side, tandem to each other. The free air enters between the two pistons and passes by a large annular valve through the piston and into the working end—the end toward the steam cylinder—of the low-pressure cylinder. The return stroke of the low-pressure piston drives the air through the long horizontal intercooler, the end of which is seen above the left-hand tank, and into the first intermediate cylinder; both these cylinders being on the left hand, and the last named cylinder nearest to the spectator. From this cylinder the air passes up and across to and through the right-hand intercooler and into the second intermediate cylinder, which occupies the same relative position as the low-pressure cylinder on the other side. The intercooler for the air between the second intermediate and the high-pressure cylinders consists of a copper coil lying in the bottom of the tank, so that none of it is visible.

After the air is discharged from the high-pressure cylinder, at a pressure of from 2,000 to 2,500 pounds, it passes through another large cooler, where it is effectually and finally cooled to normal temperature, and it is also drained of the water which at this stage is precipitated in considerable quantities.

The air-storage reservoir, into which the air is finally delivered, and the upper part of which is shown in Fig. 3, consists of 144 Mannesmann tubes 9 inches in diameter, 24 of them being 21 feet 6 inches long, and 120 of them 15 feet 6 inches long, the series comprising four complete sets of tubes as used in the locomotive, and having therefore four times the capacity of the locomotive. As the locomotive is charged with air at a pressure of 2,000 pounds, the storage reservoir must, of course, carry a somewhat higher pressure, so that the locomotive may at any time be recharged without waiting for the compressor, which can do its work while the locomotive is running. The pipes of the storage reservoir are arranged and connected in sets, so that either set may be used or thrown out, may be charged or discharged, without interfering with the others. In the operation of recharging the locomotive, this separation of the different sets of pipes is found a great advantage. The reservoir being filled throughout with air at, say, 160 atmospheres, if the pressure in the locomotive to be recharged has fallen, say, to 20 atmospheres and connection is first made to only one-quarter section of the reservoir, the air in that section will be drawn down to a lower pressure, or more air will be delivered by that section to the locomotive, than would be delivered by each section if all were connected at once. This practice is therefore adopted, and each section is successively connected and allowed to deliver all that it will before the next section delivers its share. The operation of recharging is a short and simple one, the working of the successive valves not occupying any appreciable time.

We cannot at present speak more fully of the arrangements of this interesting plant. We are, however, permitted, in connection with the half-tones, to present a full set of indicator diagrams, taken with the compressor in full operation. These it is considered best to present without remark, as computations and discussions with which we do not wish to interfere are still in progress. The diagrams are reproduced full size, and the scale of each is as follows:

	Scale.
No. 1—Right Crank End, Steam.	60.8
No. 2—Right Head End, Steam..	60.0
No. 3—Left Crank End, Steam...	59.4
No. 4—Left Head End, Steam...	58.8
No. 5—Low Pressure Air.....	40.0
No. 6—First Intermediate Air...	107.1
No. 7—Second Intermediate Air..	432.0
No. 8—High Pressure Air.....	1,300.0

▲ ▲ ▲

Imitation "Damascus" Gun Barrels.

In a report to the State Department, United States Consul Gilbert, at Liege, Belgium, says that the trade in Damascus gun barrels, of which the valley of the Visdre in Belgium enjoys the exclusive monopoly of production, has for some years suffered severely from several causes, principally from the placing on the market of steel barrels in imitation of Damascus. The difference between the genuine and false Damascus is that the real hand made barrels are composed of iron and steel manipulated by the most expert artisans, who are specialists in this art, whereas the imitation barrels are made of iron or steel, and by an ingenious process of transferring the design of Damascus from paper to the barrels are made to appear in finish equal to the real. The workers of true Damascus barrels are paid 67½ to 77 cents per day (piece work); those engaged on false barrels, principally women and children, receive from 19 to

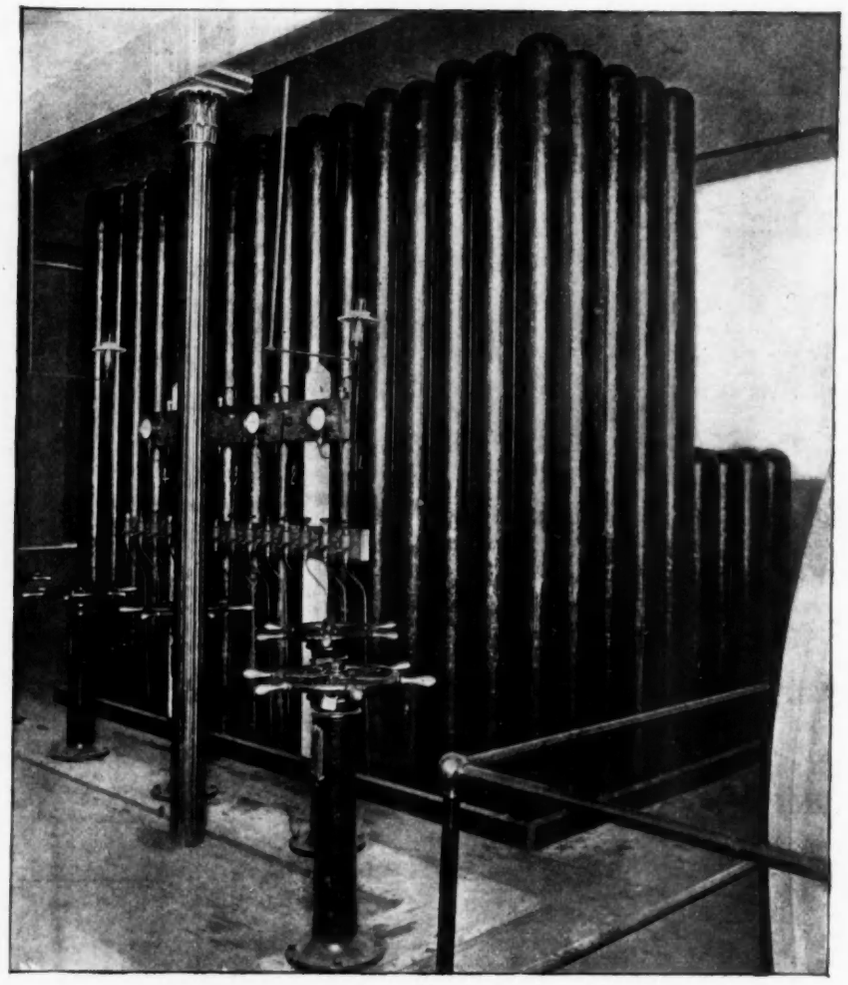
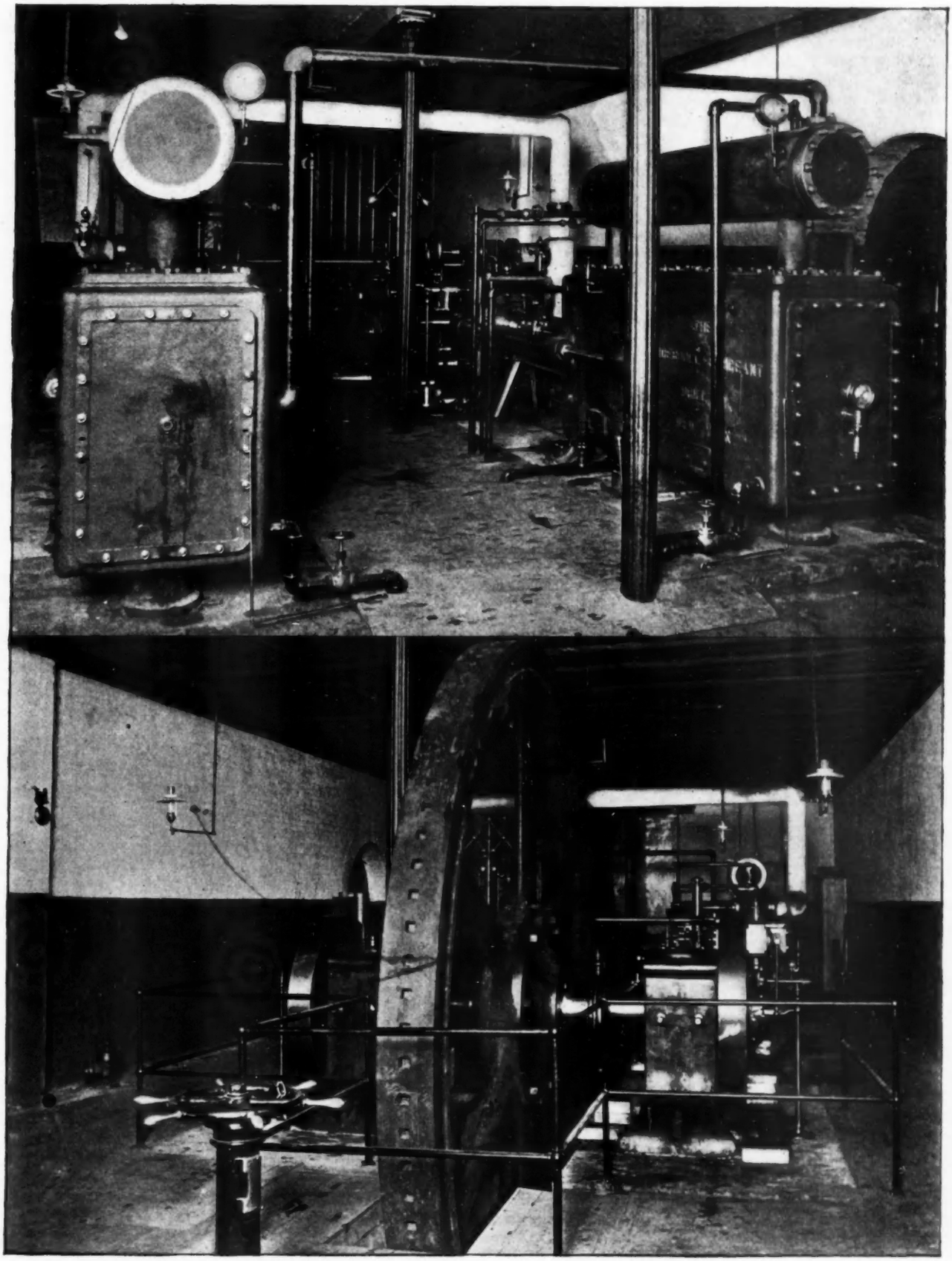


Fig. 3. HIGH-PRESSURE AIR RESERVOIR, MANHATTAN ELEVATED RAILWAY.

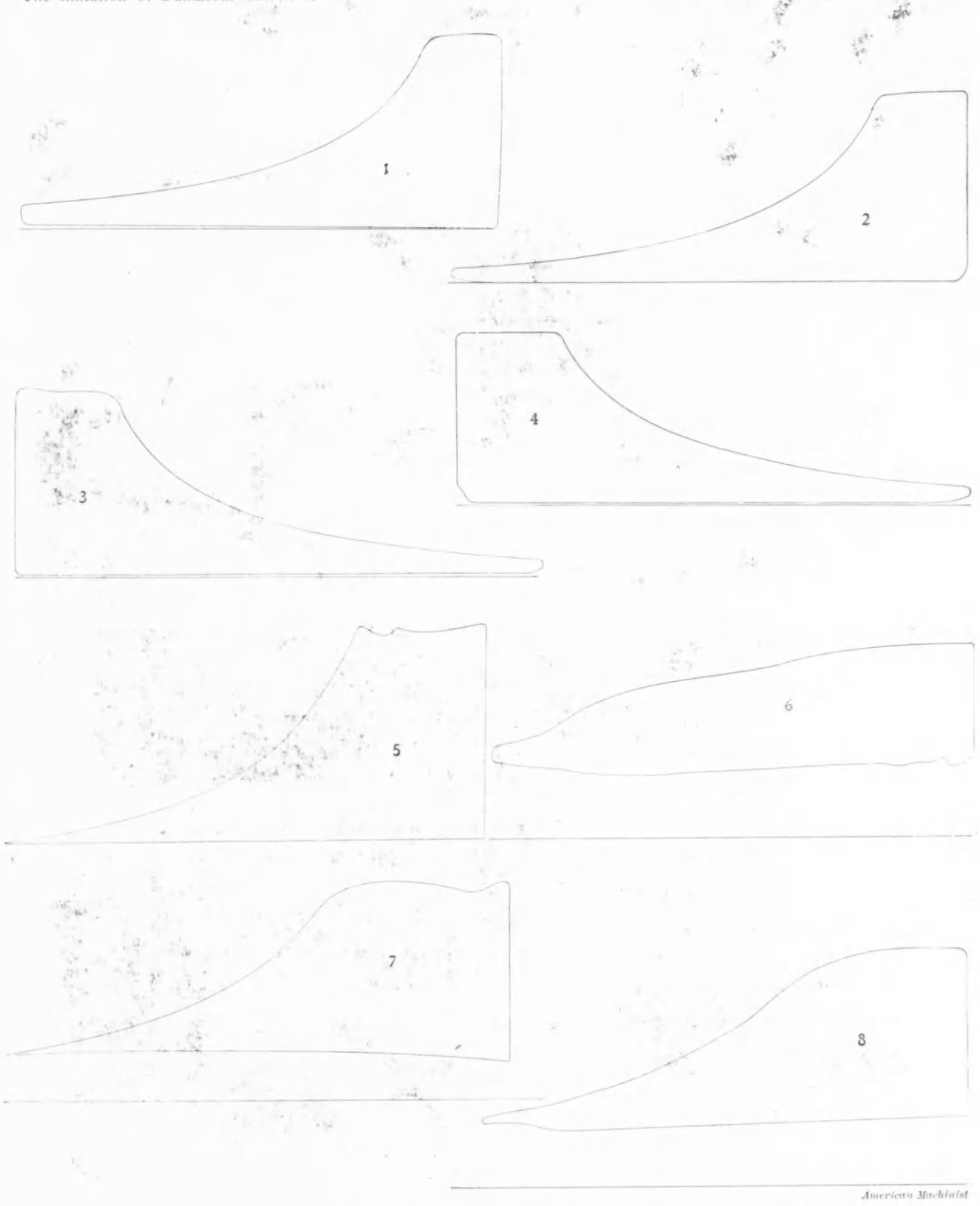


Figs. 1 and 2. HIGH-PRESSURE AIR COMPRESSOR FOR MANHATTAN ELEVATED RAILWAY.

29 cents per day. The paper designs costs about 12 cents.

The imitation of Damascus barrels is largely done in Liege by the most important gun makers, and it is calcu'ated to deceive the inexperienced buyer. It is estimated that ninety per cent. of the guns produced in Liege for exportation to the United States have false Damascus barrels.

The life of steel barrels damascened, which are all officially tested, is as great as the real Damascus, and they will probably resist as many shocks. The advantage, however, of the hand made Damascus barrel over the steel is said to be that in case of explosion, the charge escapes through some of the many welds, and the barrel does not fly into pieces, as is the case usually when steel barrels burst.



INDICATOR DIAGRAMS FROM HIGH-PRESSURE AIR COMPRESSOR. (SEE PAGE 24.)

Repairs of Electrical Machinery—False Alarms.

BY A. R. HARRIS.

It is not an uncommon occurrence for a generator to lose its vitality, so to speak, without any apparent cause. For some reason, which to the attendant appears to be very mysterious, it gradually fails to keep up the voltage to the proper point, and in order to overcome this growing weakness, more and more of the field regulating rheostat is cut out, until finally there is no resistance left in the field circuit. Then, as the voltage continues to drop, the speed is increased, and in the course of time may be raised ten or fifteen per cent. above the standard rate. During all this time a conviction gradually grows in the mind of the attendant that there is something radically wrong, and every cause for the abnormal action, except the right one, is thought of. One of the most common conclusions arrived at is, that the magnets have lost their virtue, that the iron for some unexplained reason has got into a condition where it fails to become magnetized as much as it should. In some instances it is believed that the wire has become crystallized by the constant passage of the current, and that in consequence of that fact the resistance has increased to such an extent that the current cannot get through, and that the only remedy is to rewind the whole machine.

Occasionally when a machine acts in this way there is some actual defect present, but in the great majority of cases there is nothing the matter except improper adjustment, loose connections, or the accumulation of dirt at points where it can serve as a conductor of the current, or a combination of all these disturbing causes. To be able to trace out the real cause of such disturbances, it is necessary to understand the principle upon which the machine acts, and this can be shown clearly by the aid of Fig. 1, which is a diagram of the armature, the field coils and the field regulating resistance, all connected in their proper relation with each other. The office of the field coils is to magnetize the machine, that of the armature to generate the current. The armature may be looked upon as a pump that draws the current in through the wire *D*, and forces it out through the wire *E*. Now, as the current is forced out through the wire *E*, it will not only follow this wire, but if there are any outlets from it, it will also pass into these. As will be seen from the diagram, there is an outlet at the junction *F* which leads to the bar *P* and the connecting switch *S* of the field regulating rheostat *R*, and thence through the field magnets *M M* to the wire *D*. In this diagram the armature is divided into eight sections, for the purpose of making the explanations simple, but the action would be the same if there were ten times the number of sections. It was stated above that the armature may be considered as a pump, but it is better to consider it as made up of a series of pumps, each section representing one pump. By tracing the current as indicated by the arrows, we will see that it is drawn in from the wire *D*, by way of the brush resting on the contact *C*, and is forced along on both sides of the armature to the lower brush, through which it passes to the wire *E*. The sections 1, 2, 3, 4 on one side of the armature, and 8, 7, 6, 5 on the other, can be regarded as so many pumps. Now, if they are tight, and the current cannot slip back, the same amount will be pumped at all times at the same velocity, and therefore the pressure will remain constant, other things remaining unchanged; but if there is a leak there will be less current pumped, and the pressure will be reduced. The difference between the action of pumps and an armature is, that the latter can increase the amount of current pumped through at the same velocity, so that if the passage through the wires *D E* is free from obstructions, more current

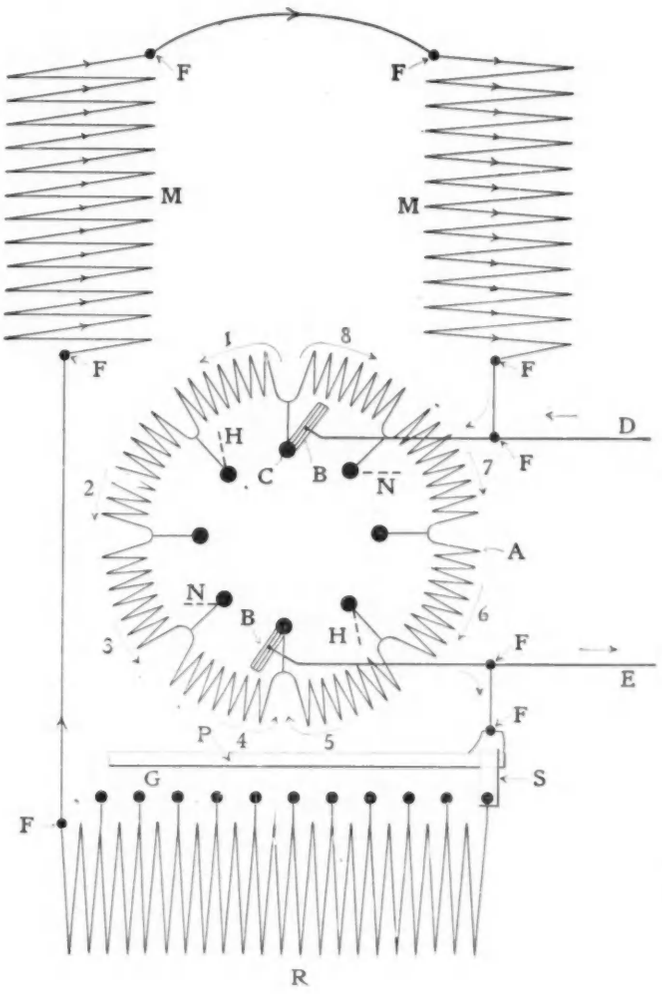


Fig. 1

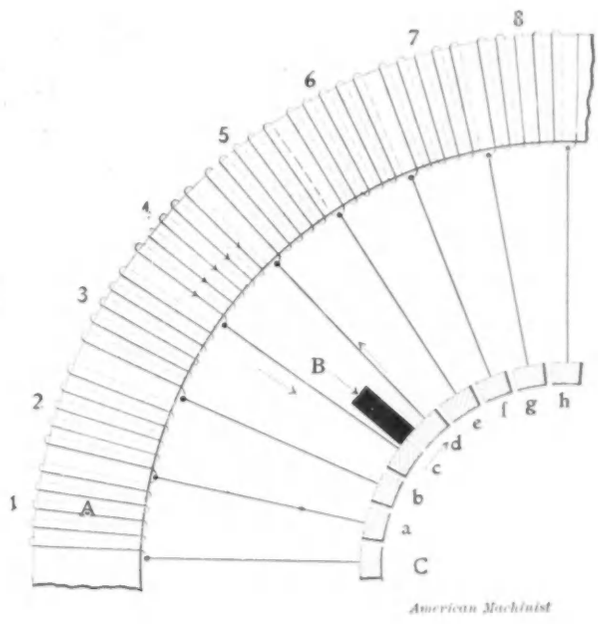


Fig. 2

will be forced through than if it is not, the amount at all times being as much as the uniform pressure against which the armature can pump will permit. A water pump would do the same thing if it could be constructed with a cylinder that would expand and contract automatically, so as to always pump enough to keep the pressure up to the standard. If the pressure is maintained constant, the amount of current that will pass through the field coils *M M* will be always the same; therefore the strength of the field magnetism will remain the same, unless some additional obstruction is placed in the field circuit. If the pressure developed by the armature is reduced, the current passing through the field will be reduced, and as a consequence the magnetism will become less, and this will reduce the pressure developed by the armature. If the resistance to the passage of the current through the field coils is increased, the amount of current passing through them will be reduced, and thus in this way the magnetism of the field will become less and the pressure developed by the armature reduced. As will be seen from the diagram, there are a number of points marked *F* where the various parts of the field circuit are joined to each other, and if any number of these become loose or corroded, there will be an increase in the resistance. The difference in the pressure caused in this way is not likely to be very great, as the increase in resistance cannot become decided without detection. If some of the joints become loose or badly corroded, so as to materially increase the resistance, so much heat will be generated at these points that the smell will give warning, and if not attended to in time the result will be that the defective joint will burn out.

With the armature, however, the case is very different, and the leakage that can take place without doing damage can be sufficient to actually prevent the machine from generating, if it is a simple shunt-wound machine. As will be noticed, the points where the several sections of the armature come together are connected with black dots which represent the segments of the commutator. Now, if there is a chance for the current to leak back from one commutator segment to another, the result will be to reduce the pressure developed by that particular section of the armature. The effect would be equivalent to that taking place with a loose piston in a pump cylinder. If the construction of the cummutator is such that there are many places where dust can accumulate, the segments can become connected with each other, although in an imperfect manner, through the medium of this dust, especially so if the brushes are metallic, and the reduction of pressure can in this way be sufficient to stop the action of a shunt-machine, as previously stated. To guard against trouble from this source, all the places where dust can accumulate should be covered with insulating material, and the dust should be removed as fast as it collects, by wiping off where possible, and blowing out in all other places.

If the brushes are not set at the proper points on the commutator the pressure will also be reduced. As will be seen from the diagram, the current entering through the top brush will divide and pass in two paths, each through one-half the sections of the armature before it reaches the lower brush, but if the brushes were advanced to the position *H H* each current would pass through three sections that would pump it ahead, and one that would pump it back. The pressure of the section acting in the reverse direction would offset the effect of one section acting in the forward direction, therefore the net pressure would only be equal to that of two sections. The result would be the same if the brushes were set back to the position *N N*. If they were set at any intermediate point, between the true position and either *H* or *N*, the effect would be to cause a part of the armature section between these positions to act against the other. If the displacement amounted to one-quarter of the length of a section, the back pressure would offset the forward pressure of one-quarter of a section, and the actual loss of pressure in the circuit would be equal to one-half a section.

The reason why the action of a simple shunt-wound machine can be entirely stopped by a sufficient reduction in the pressure is, that when running at any given velocity, it must have a certain strength of current flowing through the field to develop a given pressure in the armature. Now, to force this amount of current through the field requires a certain amount of pressure, and if this is greater than the pressure developed by the armature, it follows that the latter cannot force through the field as much current as is required; hence, the machine will not generate. If the pressure required to force the necessary amount of current through the field is less than the pressure developed by the armature, it also follows that there will be an excess of current flowing through the field, and therefore the pressure developed by the armature will be more than that required, unless the field current is cut down by the insertion of additional resistance in the field circuit. It is on this account that the rheostat is used. If a machine is compound-wound it will always generate some current, unless the speed is only a few revolutions per minute, owing to the fact that when the shunt coils fail to act, the series will still magnetize the field to some extent.

Sometimes compound-wound machines fail to develop the proper pressure, owing to the fact that the series coils have been connected in the reverse order, so as to have the current in them work against the shunt, instead of with it. This can only occur through carelessness, ignorance or malice.

Occasionally, when a machine begins to act unsatisfactorily, the attendant notices that when one brush is placed in position it will spark slightly, and he will at once conclude that this is an indication of some serious defect, but it is not. A single brush resting on the commutator will spark, if the machine is large, and why it should can be easily understood from Fig. 2. This figure represents a section of a ring armature, with the commutator segments *a b c d e f*, etc., to which the ends of the wire sections are connected. As will be noticed, the two ends of each section connect with two commutator segments adjoining each other, and if a contact is made between these, the effect will be to short-circuit the coil to which the ends belong. When the brush shown at *B* laps on two segments, it forms such a connection, and a closed circuit through the coil 4 will be maintained so long as the brush presses on the two segments *c d*. The field of an electric machine never becomes entirely demagnetized; therefore, if the armature is rotated, even when there is no current passing through the field coils, a current will be generated in any section that is formed into a close circuit by the lapping of the brush on two commutator segments, as shown in the figure. If the brushes were located at the neutral point, that is, directly at right angles with the center line of the poles, there would be no current generated, because in this position the wire moves parallel with the magnetic field and not across it, but in all machines the brushes are set ahead of this line, and are therefore in a position where they can short-circuit a coil in which a current will be generated. When the leading segment passes from under the brush the circuit must break, and as a result there will be a spark. If the machine is small, the current developed will be so weak that the spark will not be visible, but if it is large it will be, and the greater the lead of the brushes the larger the spark. Thus it will be seen that the sparking of a brush when the other one is not in position is not an indication of any disordered condition.

The conclusion to be arrived at from what has been said in this article is, that when a machine begins to behave abnormally, it should not be inferred at once that there is something radically wrong, but, on the contrary, that there is simply some part slightly out of adjustment, or an accumulation of dirt at some point where it can interfere with the proper action. The trouble in most cases is apt to be of this nature, and therefore no effort should be made to look for it in any other direction until the expedients pointed out herein have been resorted to and have failed to restore the normal action.

English and American Lathes.

The "English Mechanic and World of Science" is publishing an interesting and discriminating analysis of the merits of English and American lathes. Of course, the flat top *vs.* the V-topped shears come in for attention, and in the article appearing March 19th, the old and new Sellers sections of bed were compared with the Whitworth section. The article has called out the following letter from Wm. Sellers & Co., which we reproduce as of decided interest. The letter with the illustrations is self explanatory:

The article in the "English Mechanic and World of Science" (March 19, 1897) on "English and American Lathes" is an interesting study of this subject from the point of view of a careful observer and accomplished writer. Without desiring to criticise in any way the description given of the flat-top shear, described and illustrated in this article, made by Wm. Sellers & Co. (Incorporated), Philadelphia, a brief supplemental account of some of the points of advantage, both in facility of construction and superior maintenance of accuracy under constant and severe service, may be useful.

The merit of the flat-top shear was early recognized by the firm of Wm. Sellers & Co.; but their attempt to introduce it nearly proved a failure from the impossibility of maintaining the fit between the poppet-head and the shear and the alignment of the live and dead spindles which is dependent thereon. In 1869 this defect was remedied by the introduction of the under V, shown in your illustration, No. 7, in the article above alluded to, which has a vertical guide on the inner edge of the shear against which the poppet-head must be drawn by the act of clamping it to the shear. As there is no wear upon this vertical face, nor upon the contiguous tongue of the poppet-head, true alignment of the spindles is maintained under all circumstances, because the line of centers and accuracy of work are not dependent upon the lateral fit of the movable head between the two sides of the shear. The necessity for making a tight fit between the movable head and the shear being entirely avoided, no adjustment for wear by means of "setting-screws" is required.

The illustration, Fig. 7, shows an early form of flat-top shear having its outer edges beveled at an angle inclining inwards from the face of the shear, following the Whitworth design shown in Fig. 9. The illustration, Fig. 8, shows the shear as now made with outer edges perpendicular. Respecting this change the writer says: "The reason for making the edges of the shears perpendicular, as in Fig. 8, instead of beveled, as in Fig. 7, was to diminish possible inaccuracy due to wear of the edges and flat surfaces." This statement is not sufficiently comprehensive, and therefore fails to explain the real significance of this very important feature, which has reference to the slide-rest or the saddle. When the outer edges of the shear are beveled and these faces are made to receive the holding-down gibs or shoes of the slide-rest, the wear of the top surface of the shear, which practically is the only part of the shear which wears at all, loosens the fit of the slide-rest and permits lateral movement. If this is taken up over the worn part, it will prevent the saddle from moving over the part

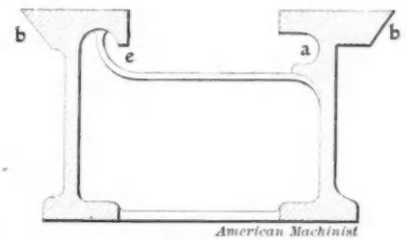


Fig. 7

THE OLD SELLERS BED.

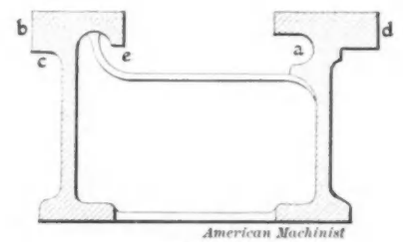


Fig. 8

THE NEW SELLERS BED.

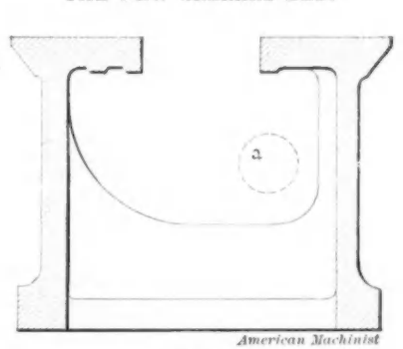


Fig. 9

THE WHITWORTH BED.

not worn, the only remedy for which will be the entire readjustment of all the surfaces. By making the guiding edges of the top of the shear vertical, the wear upon the top of the shear will not affect the fit of the slide-rest laterally. This improvement was introduced in 1881, and the combination of the two improvements —viz., the under V for securing alignment of the spindles and the outer vertical guiding surfaces for maintaining the traverse of the saddle in planes parallel to the axial line of such spindles—produces a lathe which will maintain the conditions for exact work indefinitely.

WM. SELLERS, President.
(W. Sellers & Co., Incorporated.)

Letters from Practical Men.

The Mathematician vs. the Constructor as a Student.

Editor American Machinist:

Will you permit a "constant reader," an old, or at least middle-aged, practical engineer, and an "ancien élève de l'Ecole des Mines de St. Etienne" to boot, to add a few words to the discussion of "The Mathematician vs. the Constructor as a Student," now open in your paper?

In my opinion the true function of the technical school is to teach well and thoroughly the sciences upon which the different branches of engineering rest, with the application of said sciences to said branches—and no more. That is to say, it should teach the science but not the art of engineering. The first it can, the second it cannot do. The practice of engineering can only be learned in real, and not play work, and under the direction of practical instructors (of which personal experience is one of the best). If the college professor is thoroughly competent, from long study and practice in teaching, to instruct in the science, he cannot possibly be competent to instruct in the art, because life is shorter than the combined lengths of both art and science. If he has some practical knowledge, so much the better; only he should not attempt to impart it as such, but simply use it to modify and direct his theoretical instruction.

At our technical schools the student studies too much and learns too little. He spends four years—a tremendous slice out of a man's life—in getting a superficial knowledge of a mixture of theory and practice, and, worse than this, comes out too often with a false estimate of the value of what he has learned. He is, of course, far better equipped than the man who has not been through college, but he knows too many things slightly and too few thoroughly for time and money spent.

My crude idea of a proper engineering school would be one where elementary mathematics, up to the Calculus, and enough of this to make the student perfectly familiar with maxima and minima, was taught; with elementary applied mechanics, so that he could readily solve all practical problems of statics and dynamics; practical hydraulics and the simple rudiments of machinery, with a very little chemistry and geology and a great deal of draughting of all kinds, and, of course, the principal calculations incidental to surveying. Let all this be taught, with a few etceteras, dwelling always on the most rudimentary stages, well and thoroughly with much repetition, in two years. Then let the lad hunt a job, with the full assurance that he has sufficient book learning to become the chief engineer of pretty nearly any enterprise, and that his reaching or not reaching such a position will depend upon other factors than his school education.

So much for the engineering school

pure and simple. For those who have time, money and inclination, let there be special post-graduate courses, which can be taken up either immediately upon finishing the above programme, or at any subsequent time, as occasion may require. In these let there be taught all that there is to be learned about bridge calculation, the steam engine, electricity, metallurgy, geodesy, high, higher and highest mathematics, with as many etceteras as you feel inclined to add. The general, all-around engineer needs the two years' course, but does not need these. If he finds, after a trial of real life and real work, that he desires to become a specialist, and can afford time and money to gratify this desire, let him pitch in for post-graduate work.

How does all this strike you? Have I thrown any light upon the question, or have I still further obscured it?

E. S. G.

Yonkers, N. Y.

▲ ▲ ▲

Turning Slim Wood Work—Roughing Pattern Surfaces.

Editor American Machinist:

To turn a piece of wood the diameter and length of which are not disproportionate is quite a different thing from turning a piece whose length is anywhere from twenty to fifty times its diameter. I have seen men, fair turners on the former, who could not be induced to attempt anything like the latter. Fig. 1 shows a specimen of "Jack" handles that I often have to turn; the sketch gives the sizes. The material for one order was sent me with the corners taken off; but they can be turned much quicker by putting them in the lathe with corners on, as shown.

The first step is to turn down midway between the 3-foot 9-inch point and the end to the size required, and next, to work back toward the largest part, then from the first point to end, finally turning the end for the shank. Fig. 2 shows a primitive steady rest, wherein lies the secret of success. As shown, the one hand engages the work and tool—either gouge or chisel—while the other hand holds the handle of the tool firmly. It is understood that, in order to turn wood parallel with its axis and smooth, the chisel is tilted on the rest slightly, enabling the workman to take a shearing cut. Never let it scrape, if possible to avoid it. Sometimes it is necessary to hold the tool with one hand only, the end of the handle resting against the operator's body; the other hand laid full length against the back of the work opposite the tool.

Figs. 3 and 4 show tool and work for "roughing" such faces of patterns as the tops of steam-chest casings, steps and any casting that has to be stepped upon. I have tried several ways, but find the enclosed the most effective and simple. Two bits of steel (Fig. 5) are ground to proper shape as slitters—one is fixed firm between two pieces of hardwood screwed together and projecting just far enough for proper depth; the other is inserted the right distance apart for the size of the blocks, but is loose enough to slide, so that it can be pushed down far enough to engage the previous cut—at the same time as the next cut is made, it must slide back, or else the cuts would be made still deeper. I put a middle line each way, made with a cutting knife, and work each way from that. If it is a large surface it is necessary to occasionally correct the line with the square or straight edge, else the blocks will be anything but straight. After the work is blocked out both ways, it is an easy thing to point them with the paring chisel without a guide, if it is held just the right angle, which the eye soon determines. If any pattern-maker who has not tried this way will give it a trial, I am sure he will be pleased. It is not often that this work has to be done in an ordinary repair shop, so it does not pay to make anything very elaborate.

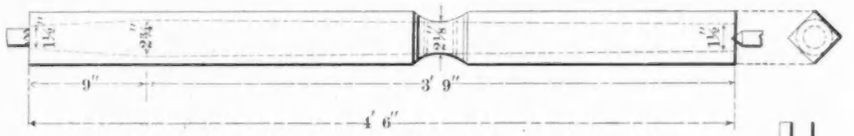


Fig. 1

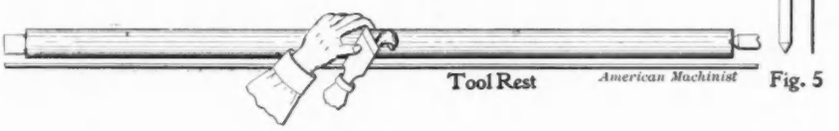


Fig. 5

Fig. 2

TURNING SLIM WOOD WORK.

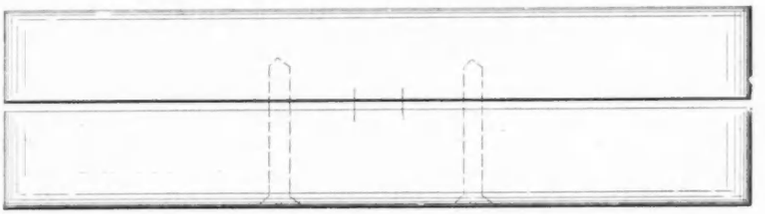


Fig. 3

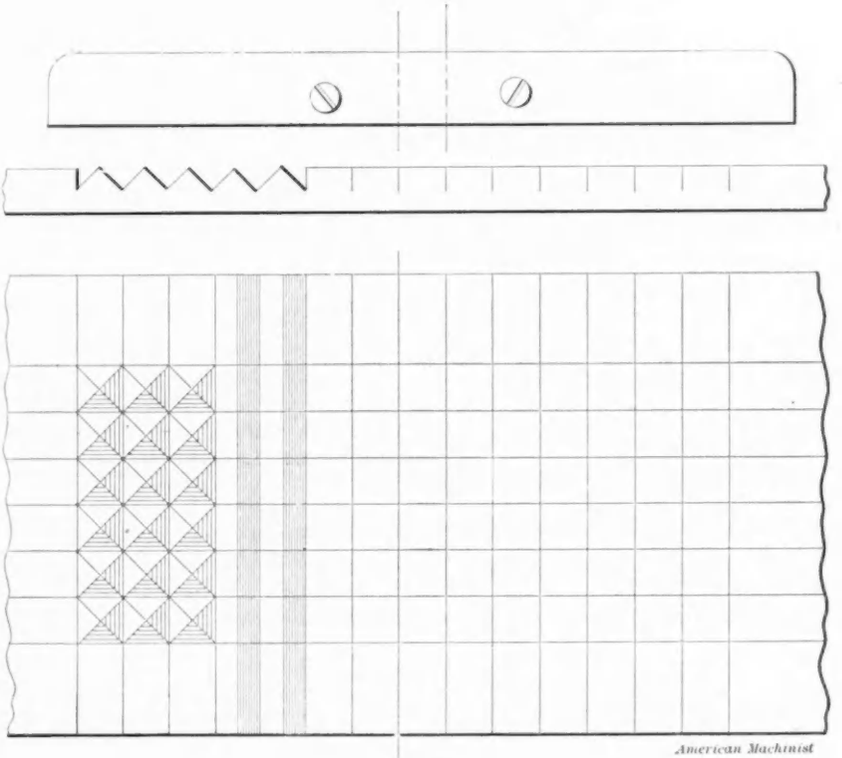


Fig. 4

ROUGHING SURFACES.

Oneonta, N. Y. WM. NEWTON.

A Difficult Casting.

Editor American Machinist:

We have a casting to make, like sketch, and we fail so far to get a good one. Could you, or some of your experienced molders, suggest a remedy? Our castings are not solid at the place marked *A*. You will notice that this is a hollow chamber with core opening on one side only, and the trouble is that the vent does not get out on the side where there is no hub, causing a porous casting. This is an ammonia cylinder (part of it), and has to stand a high pressure in making ice.

ROBERT KING.

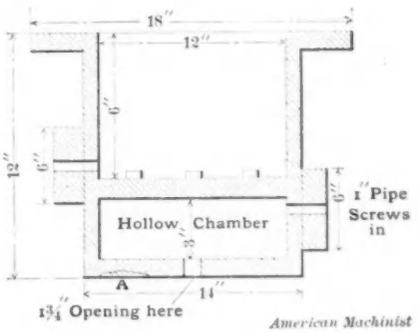
Editor American Machinist:

It is not stated how or in what position this casting has been made. I infer from the location of the porous portion that it was uppermost when cast. There is but one opening shown for vent of core, 12 inches diameter, 3 inches thick, and that vent is the 1-inch pipe hole, probably cored out to ¾-inch. The safe way to make this casting is to cast on end, that is, with flanges up, hollow chambers down. Have an opening at least 1¾ inches in diameter, or 2 inches is better, in the end as shown by dotted lines. The 1-inch hole for pipe in the hub, on the side, it is better to drill, than to attempt to core out, takes less time in the machine shop, with any kind of rigging, than it does to hazard the success of the entire casting labor for cores, and all to core a ¾ or ⅞-inch hole through 3 inches or 3½ inches of iron 6 inches diameter in the foundry. The 1¾-inch or 2-inch diameter hole in the bottom as shown, enables the core and core arbor to be extracted without much difficulty. If the powers that be will concede the hole in the bottom, the best practice is, to cast a ring as light as possible (it is supposed this is round), with short rods, some 2 inches apart cast in this ring. Take out and cast a ring on the other end of these rods, like sketch. This forms a back skeleton for the core, and by laying rods across allows for the inside to be filled with small cinders, that can be connected with the print 1¾ inches in the bottom. That will let what little vent there may be off freely, and insure the peaceful filling of the mold. without doubt if the core is dry and mold is properly secured, to prevent leaking or iron getting into vent.

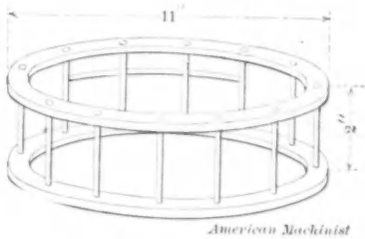
Now the iron mixture that is poured into the castinges for ammonia is an important, in fact *the* important, factor for ammonia pressure resistance. The iron should be very dense, and close grain, and when it is so close, dense and hard that the machinist says he'll be d——d if he will ever finish another one as hard as that, then the mixture is about right for ammonia. The foundryman should keep it right there. With a core made as described there is not a great amount of core sand in its construction, consequently but little gas is generated.

This is quite a lengthy answer, but I think it is all needed. The trouble with this kind of casting is that the designer, proprietor and foreman of the machine shop, one and all, will let the foundry lose castings, pile on pile, rather than make reasonable provision to let off vent or get out the cores, spending often from $10 to $20 in waste of labor and material in the foundry to save half an hour's time or so in the machine shop.

L. C. JEWETT.



A DIFFICULT CASTING.



SKELETON FOR CORE.

▲ ▲ ▲

A Remarkable Hoisting Engine Performance.

Editor American Machinist:

Noting the article in a recent issue of the "Machinist," regarding the engines in use at the Lake Superior Mines, I trust that you will give space to the following, which is not intended as a free advertisement for the firm employing me, but simply to give your readers the particulars of what I would term, "a remarkable hoisting-engine performance."

Some five years ago we built for the W. D. Johnson Coal Company, at Boone, Iowa, a pair of geared hoisting engines having cylinders 10 inches diameter by 16 inches stroke. They were the first engines of a new design, of the "Tangye" bed type, and are coupled quartering to the same main shaft. The drums are 72 inches diameter, the spur gear 80.8 pitch diameter, and the pinion 20.2 P. D., making the ratio of gearing 4 to 1.

While visiting the company's mines recently, I was struck by the terrific speed of the engines while hoisting, and asked the engineer if he always ran the engines that fast, to which he replied, "I just give her the steam, and she does the rest." This led me to investigate, with the following results:

Length of hoist—253 feet.

Circumference of drum at center of rope—19 feet.

Time consumed in hoisting—5½ seconds.

Average speed of rope in feet per minute—2,760.

Rate of revolutions of drum per minute—145.2.

Rate of revolutions of engines per minute—580.8.

Piston speed of engines in feet per minute—1,551.

Average unbalanced load in pounds—1,800.

Horse-power developed by engines—150.5.

A piston speed of 1,551 feet per minute and a hoisting speed of over 31 miles per hour is not "very slow," and think of cast-iron molded gears running at a periphery speed upwards of 3,000 feet per minute!

The engines seem to stand up all right under this severe duty—the engineer claiming that he frequently hoists in 5 seconds, and that the time varies from that to 10 seconds according to the steam pressure and the amount of coal to be loaded in a day. Nothing special is claimed for these engines, except that they were built as well as we knew how, are very heavy and thoroughly self-contained, and I mention it to simply show that in practice some things are accomplished which one would not dare to contemplate in the designing of a machine or transmission. I should like to hear from some of your correspondents and to learn if the above engine performance has been equalled or surpassed.

GEO. W. AULMANN,

Des Moines, Ia.

▲ ▲ ▲

Fastening Emery Cloth on Iron.

Editor American Machinist:

In the "American Machinist" of May 20th, Mr. E. Lawrenz describes "a very good, if not the best, way of fastening emery cloth to face plates." A better, "if not the best," way is to substitute shoemakers wax for the beeswax recommended; it costs less and holds fully as well, if not better.

The plate should be heated just enough to melt the wax when brought in contact. Take a lump of the wax and coat the face of the plate liberally, using reasonable care to cover every part; lay the emery cloth, or paper, on the plate and then place it, face down, on a smooth flat board. Give the plate a few "twisting turns," at the same time pressing on it. Trim off the edges after the wax has cooled. If the face plate is light, a heavy weight placed upon it, while cooling, will help matters.

Shoemakers wax is "hot stuff" in warm weather; but if it is kept in a tin can, immersed in water, it "aint so warm."

THEO. ALTENEDER, JR.

Philadelphia, Pa.

AMERICAN MACHINIST

Published Thursdays by

American Machinist Publishing Co.,
256 Broadway, New York.

John A. Hill, President and Treasurer.
C. A. Hansmann, Sec'y.

▲ ▲ ▲

Editoral Department.
Fred J. Miller, Chief.
Frank Richards,
F. A. Halsey,
Edward P. Buffet, } Associate Editors.

▲ ▲ ▲

Illustration Department.
A. L. Donnell, Chief.

▲ ▲ ▲

Advertising Department.
C. P. Day, Eastern Representative.
J. M. Wakeman, Western Representative.

▲ ▲ ▲

Space in advertising pages only is for sale.

We invite correspondence on subjects pertaining to machinery.

Name and address must always be given, though not necessarily published.

Communications for or relating to the reading columns should be addressed to the Editor. All business communications should be addressed to the Company.

Subscribers can have their mailing address changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once. Date on wrapper denotes week with which subscription expires.

▲ ▲ ▲

SUBSCRIPTION PRICE:

$3.00 a year in advance, postage prepaid in the United States, Canada and Mexico.

$4 00 a year to other countries, postage prepaid.

Entered at Post Office, New York, as second-class mail matter.

For Sale by Newsdealers, Everywhere.

No back numbers beyond 1896.

▲ ▲ ▲

The Invention of the Bessemer Process.

Our readers will remember the paper by Sir Henry Bessemer, which was read at the last December meeting of the American Society of Mechanical Engineers, on the History and Development of the Bessemer Process, and they will also remember the discussion which it brought out, in which Sir Henry's claims as the originator of all that constitutes the Bessemer system were denied. They may not know, however, that at the February meeting of 1896 of the American Institute of Mining Engineers, the presidential address of Mr. Jos. D. Weeks covered the same ground. The address was essentially a re-statement of well-known and established facts going to prove that of the three elements of the Bessemer process, Wm. Kelly was the first inventor of the pneumatic principle, Sir Henry Bessemer of the mechanical application of that principle, and Robert Mushet of the recarborization with spiegeleisen.

It is believed by many that Sir Henry Bessemer's paper was intended primarily as a reply to Mr. Weeks, and in consequence of hostile comment arising, in Mr. Weeks' belief, from misunderstanding of his meaning, his address was withheld from official publication until he should have so modified or added to it as to make such misunderstanding impossible. This revision of the address was, however, prevented by Mr. Weeks' illness and death. Under these circumstances the Secretary of the American Institute of Mining Engineers has assumed the responsibility of publishing such portions of Mr. Weeks' address, together with its appendices, as have a historical value and are beyond controversy. This version of Mr. Weeks' address appears as one of a recent issue of Institute papers. The appendices published include testimony given in the case of the patent office interference of Wm. Kelly and Henry Bessemer, together with various affidavits, and the final decision of the commissioner of patents, in which priority of invention is awarded to Kelly and a patent is ordered to be issued accordingly.

A piece of testimony by Alexander L. Holley is also given, in which he says, "I consider Kelly's invention the first practical development of the pneumatic process, and it has been so recognized by the owners of the combined patents covering this process."

In view of all this testimony, it is difficult to understand the motive which led Sir Henry Bessemer to the production of his last paper, and it is still more difficult to understand what could have led an official of the American Society of Mechanical Engineers to endeavor to belittle the evidence in the case in the public prints of Great Britain.

▲ ▲ ▲

For Health and Comfort in Summer.

We are now close upon the season which brings with it a vast amount of discomfort, and many conditions that seriously menace our health. The hot season in town is the terror of the year, and the only time when those who may are glad to run away to any place that gives promise of a little relief. We meet the Summer as cowards, while Winter, essentially more fierce, we face and fight and conquer. When the mercury begins to fall and the chilly winds to howl we close our doors and windows and have no difficulty in securing perfect comfort, so far at least as temperature is concerned. We may yet see the day when it will be considered just as proper to close our doors and windows tight in summer as in winter. Why not? We certainly can never get a constant comfortable temperature of, say 70 degrees inside with 100 degrees in the shade outside and doors and windows wide open. We have our refrigerating processes for dead poultry and cattle, why not also for live men and women? Why would it not be a most profitable scheme for the managers of, say, one of our modern office buildings to begin the practice of providing, besides all the conveniences now so universal, a comfortable and perfectly equable temperature throughout the year? The problem is a simple mechanical one, and it is therefore within our province to mention it. There is no suggestion of novelty in our proposition nor difficulty in its complete accomplishment. The cooling of air by mechanical means is a simple matter, especially within the range of temperatures essential to human comfort and well being. The margin of temperature between the extremest discomfort and the perfect and ideal condition is really very slight. The hottest of summer is, say, 100 degrees, while 70 degrees is cool enough for any one, at least by contrast, and as cool as would be asked for. The compression of air to only five pounds per square inch above its initial pressure raises its temperature more than forty degrees, and if it is cooled while under this pressure and then allowed to expand, the fall of temperature thereby secured is nearly the same, and is certainly all that would be required for our purpose. A considerable volume of air, a volume sufficient for the entire use of one of our large office buildings could be thus compressed, cooled, re-expanded and discharged at a cost that would not be prohibitory. It is proper to remember that if such a scheme as that here suggested could be carried out, if the windows could be all closed tight, and the main entrance have the revolving doors which were frequently seen in use last winter, or some other form of air lock, and if all the air in the building was treated as proposed, it would not get rid of, but rather aggravate, the unpleasant fact and effects of humidity. If, however, only one-quarter of the air supply of the building went through the air compressor, the cooler and the rest of the apparatus, but if this one-quarter of the air supply were then compressed to say, five or more atmospheres before its final and complete cooling, and if after its cooling and re-expansion it was then mingled with three or four times its volume of uncompressed air, cooling the whole to the desired temperature, the humidity would also at the same time be always sufficiently reduced for practical comfort. Not to follow this subject further, it seems to open a very inviting field for further enterprise and skill, and seems also to promise gratifying and comforting results.

▲ ▲ ▲

Death of John Jones.

John Jones, one of the original partners of the well-known firm of Pusy & Jones, Wilmington, Del., died at his home in that city on May 21st, aged 78 years. Mr. Jones came to the United States from Lancashire, England, with his parents when three years old. His father was a machinist and engaged in the manufacture

of cotton and woolen machinery, the son being apprenticed to him from 17 years of age until reaching his majority. The firm of Pusy & Jones was founded in 1849 and the business has continued at the original location up to the present time. Mr. Jones retired from the business in 1866.

▲ ▲ ▲

Bishop Potter's Opinion of Labor Saving Machinery.

We have received from Bishop Potter a letter referring to the editorial which appeared in our issue of May 13th, in which we criticised some of his views on labor-saving machinery as published in the daily papers. In the course of this letter the bishop says: "As it happens—and as it usually happens—the report of some words of mine to which you refer was grossly inaccurate and misleading, and largely a travesty of any opinions of mine. . . . I recognize the blessings of machinery as clearly as you do. But no such blessings are obtained without cost, nor without creating conditions which must be frankly recognized."

We are glad to know that Bishop Potter's opinions are different from those attributed to him, and to give publicity to the facts.

▲ ▲ ▲

Personal.

Mr. Fred H. Colvin, formerly editor of "Machinery," will, after the 14th of the month, join forces with "Locomotive Engineering" as associate editor.

Mr. F. C. Pratt, son of President F. A. Pratt, of the Pratt & Whitney Company, is now in Europe, in the interests of the company. He has a general roving commission throughout Europe.

▲ ▲ ▲

At a meeting of Baltimore members of the Association of American Draftsmen, at No. 11 St. Paul street, Thursday evening, May 20th, a local chapter was organized. The following officers were elected: Mr. James W. Lee, of the United States Revenue Cutter Service, President; Mr. W. T. Hoofnagle, Vice-President; Mr. E. A. Osse, Secretary; Mr. W. H. Roes, Assistant Secretary, and Mr. D. D. Thomas, Jr., Treasurer.

▲ ▲ ▲

The young machinist in the small, all-around shop need have no fear for his future status as compared with that of those who wake to mechanical life in the big factories. The conditions in this respect are probably quite similar in the different trades. The following is the way in which "The Milling World" puts it: "The all-around miller in the small mill is necessarily a better miller than the average workman in the big mill. The former must understand every step and machine in the mill, while the latter generally understands a single step and operates a single machine. In the small mill the operator is expected to do, and generally can do, everything from buying wheat and stoking up to packing, selling and shipping the flour. I find many foremen of large mills who, when they find it necessary to hire subordinates, make it a practice to secure men who have had the miscellaneous experience of the small mill. Generally the miller, who when seeking work in a large mill can give satisfactory evidence of thorough familiarity with all-around small-mill work, stands a better chance than any other applicant."

▲ ▲ ▲

The use of compressed air is now so established and so extensive that an organization entitled, The Compressed Air Makers of America, has now come into existence. The members at present consist of the men employed or to be employed in the caissons of the new East River Bridge to connect New York and Brooklyn. A schedule of wages has been established, varying with the depth or pressure, as follows: From 55 to 70 feet depth, $2.75 for six hours work; from 70 to 80 feet depth, $3 and four hours work; 80 to 90 feet depth, $3.25 and two hours' work; from 90 to 100 feet depth, $3.50 and one hour and twenty minutes work.

▲ ▲ ▲

The article on "Aerine, or Liquified Air," which appeared in our issue of June 3d, should have been credited to "Electrical Engineering."

▲ ▲ ▲

Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(85) C. B., Worcester, Mass., wishes to know of a satisfactory method of shading tracings upon the back side of the cloth, so as to produce good results in blueprinting. A.—We know of nothing better than a soft pencil. If any of our readers can give a better method we shall be glad to hear from them.

(86) A. D., Pittsburg, Pa., asks: How can I melt and pour pure gum, and what is the best composition to make a mold of? A.—We understand the "pure gum" to mean india rubber. It is not melted and poured, but rather kneaded and pressed, and it is almost utterly useless for amateurs or novices to attempt its manipulation. Pure gum, also, is seldom used.

(87) H. M., Harlem, asks for a recipe for acid pickle for brass castings. A.—The following is used by one of the best brass-finishers in Boston: If greasy, the castings should be cleaned by boiling in lye or potash. The first pickle is composed of nictric acid, 1 quart; water, 6 to 8 quarts. After pickling in this mixture the castings should be washed in clear warm or hot water, and the following pickle be then used: Sulphuric acid, 1 quart; nitric acid, 2 quarts; muriatic acid, a few drops. The first pickle will remove the discolorations due to iron, if present. The muriatic acid of the second pickle will darken the color of the castings to an extent depending on the amount used.

(88) J. R. & S., Redkey, Ind., ask for instructions for fusing cast iron on cast steel. A.—It is necessary that the steel where it is to come in contact with the iron shall be perfectly clean, and in order to protect this face it is customary to give it a coat of tin. It is possible, also, that this tin assists the operation of welding by forming a low melting alloy. Where the bulk of the steel is small compared with that of the iron, the heat of the molten iron is enough to form a good weld if the mold is so arranged that the iron flows over the steel while filling the mold, but if the iron body is small compared with the steel, enough iron must be flowed through the mold and be run to waste to give heat enough to make the weld.

(89) J. W. S., Nashville, Tenn., and J. D., Coaticook, Canada, ask: What is the most practical method of bluing steel, and what degree of heat should a gas oven be kept at while bluing? A.—The "temper colors" are as follows: 425° Fahr., pale yellow; 450°, straw; 475°, orange; 500°, brown; 550°, purple; 555°, violet; 580°, blue. Bluing processes were quite fully described in our issue of October 2, 1890. We cannot here reproduce the article, but extract the following for bluing band springs for military rifles: First, coat lightly with linseed oil; then sift dry hardwood ashes over the springs with a sieve until they are covered; place them in a furnace, and heat until the color begins to change to a blue; after which they are cooled in the air, the ashes brushed off, and they are placed in a wire basket and immersed in sperm oil; when taken out they are washed in a solution of soda to remove all oil. The linseed oil causes the ashes to stick. The process is called "ash bluing." Articles to be blued must, of course, be polished and clean.

(90) S. T. W., Baltimore, Md., asks: 1. What is the melting point of aluminum? A.—We have various figures for this from different authorities, ranging all the way from 1,100 degrees to 1,400 degrees Fahr. Aluminum melts quite slowly and cannot be rushed, which has made it difficult to determine the melting point with precision. Pure aluminum is also rarely melted, more or less alloy being usually present and varying the melting point. 2. What is a good red ink to use on blueprints? Prepared inks are not satisfactory. I have also mixed Higgin's or writing inks with soda, but they blur and run on the blueprints. If I draw the lines with soda and then draw the red lines over it, I do not have the trouble, but it is double work. A.—Why not use a water-color paint, mixing it so that it will flow in the pen? 3. Can you give me a rule for the power required to start and move a load on a level, as a railroad car, or a solid mass lying on a level surface? A.—In many such cases where a "rule" is asked for, it is not a rule that is wanted, but a book or a library. Consult some standard treatise on mechanics. 4. We are getting up designs for several small compound marine engines, cylinders 3″ and 6″ x 4″; the writer would prefer to set the cranks at 180 degrees, but it is desired to set them at 90 degrees; what is the general practice, and which gives the best results? A.—The general practice is 90 degrees, and it should give as good results as the other with sufficiently roomy connections, and especially with a reheater. 5. What is considered the average amount of slip of propellers, and what

is the least amount of slip known? A.—It is impossible to say what is the average slip of propellers, as it ranges from 100 per cent. positive to 15 per cent. or more apparent negative slip. The average will, of course, vary with different kinds of work and different models of hull. With high speed, free-running craft the slip would be very different from that of a tug-boat. 6. I recently did some repairs to a bicycle, and having to put on new pedals, I put the right-hand thread in the left-hand pedal and the left-hand thread in the right-hand pedal; I have since found that the general practice is just the reverse of this; what is the reason for this? A.—The reason undoubtedly is that experience has been the teacher. This subject was discussed by a writer in our issue of May 28, 1896. The "friction" theory favors a practice just the reverse of that which the "wabble" theory would tend to establish.

▲ ▲ ▲

Standards of Measurement.

At a late meeting of the Providence Association of Mechanical Engineers, Mr. W. A. Viall, of the Brown & Sharpe Manufacturing Company, read a highly instructive paper on measuring instruments and standard measurements, from which we extract the following items:

In going over the history of the origin of the yard and meter the fact is brought out that the yard has never been legalized by act of Congress. In 1866 Congress passed an act legalizing the meter, so that the curious fact stands that in this country of feet and inches, the meter is the only standard which has been legalized by law. It appears also that in England there is no such thing as a standard inch, the only measure of length recognized by legal enactment being the yard. The responsibility for the correctness of its sub-divisions rests with the manufacturers of measuring instruments.

Our Government has in its possession, of course, an authenticated copy of the standard yard of Great Britain, this copy being known as Bronze No. 11, which was presented to the United States Government by the British Government in 1856. It is a duplicate of the "No. 1" in England and is the accepted standard. It is standard at 61.79 degrees Fahrenheit, but it appears that this is a matter of the certification which accompanied it and not of United States statutes. It is from this standard that the Brown & Sharpe Manufacturing Company have worked in originating their system of measuring instruments on the English system, corresponding comparison with the authenticated copy of the meter in Washington having been made for their measuring instruments on the metric system.

Mr. Viall states that when measuring standard plugs by the aid of the Brown & Sharpe measuring machine, differences of .00002-inch can be readily felt by those who are in no way experts in the use of that machine, while differences of .00001-inch can be readily felt by those who are expert in such work. Many years ago Sir Joseph Whitworth announced as a positive fact that the sense of touch was the most delicate means at command in making minute measurements. Mr. Viall's paper would go far to substantiate the assertion of Sir Joseph's, and Mr. Viall contends that such results show that the item of personal error is of no importance as applied to correct measurements.

Regarding the accuracy with which standard gages can be made, Mr. Viall states that is practicable to make them within a limit of .00002-inch, but he does not believe that this opinion can be based on measurements of gages made by different makers, or that any maker of gages will guarantee every gage to be within that limit six months after it is made. He does consider that they can be made and furnished within an accuracy of .0001-inch, and this degree of accuracy can be maintained indefinitely. In point of fact he says their gages are almost invariably within .00005-inch, but from the fact that steel changes, "goes and comes," in size, it is necessary to adopt a limit within which the gage can be held.

▲ ▲ ▲

Technical Books.

THE DESIGN AND CONSTRUCTION OF MODERN STEAM ENGINES. Parts 1, 2, and 3. By T. F. Scheffler, Jr., Erie Pa. Price 30 cents each.

This publication is in somewhat novel shape, consisting of blueprints, 9 x 12 inches in size, which are made from carefully prepared drawings and manuscript on tracing cloth. The sheets are all of a size, and bound together to form a pamphlet, and as indicated, are to be published in parts—one per month. The parts before us cover the frame, main journal, and cylinder, of which parts dimensioned working drawings are given together with all the calculations pertaining thereto. The publication is a very useful one, and will no doubt be highly appreciated by a considerable number of readers. The complete publication is expected to comprise twenty-four numbers.

▲ ▲ ▲

A most surprising thing is now going on in England. The locomotives of the London & North-Western Railway have heretofore been of an almost entirely unrelieved black, but this year several of their finest engines—the Webb compound locomotives—are being painted red, white and blue!

▲ ▲ ▲

The annual report of the inspector of plumbing of Providence, R. I., states that the defective jobs discovered in 1896 were 17 per cent. of the whole number inspected. In 1895 the percentage was 24, and in 1894 it was 44.

▲ ▲ ▲

The following question and answer occur in "The Keystone": Where can I buy gravers that will not break or chip off at the point? We do not think such gravers will be found previous to the advent of perpetual motion.

A recent order for pig iron received by a furnace company in the Lehigh Valley demanded that the pigs should be as close as possible to 120 pounds in weight, as they were to go to a South American port, and then to be conveyed into the mountains on mule back, two pigs to the load.

▲ ▲ ▲

In Chicago recently the steel skeleton for a nine-story building was erected in twenty-nine days.

▲ ▲ ▲

Commercial Review.

NEW YORK, SATURDAY EVENING, JUNE 5.

THE ENGINE MARKET.

In these days there is little to distinguish one branch of trade from another. They are unified in tone and sentiment, and all longing for signs of daylight. Only the other day Mr. McKinley promised prosperity to us in a most confident manner, but Mr. Wanamaker thinks otherwise. The New York "Sun," however, announces in one of the double-leaded editorial notes which betoken Mr. Dana's handiwork, that good times have already begun to come.

In regard to the business in steam power plants, specifically, few contracts are being closed. The year may be considered a little remarkable in the respect that just now, when the season is ripe for operations, they are still relegated to the future. But it is a logical concomitant of the bad times.

The feature of the engine situation which would seem to augur better business in store were it not that one might have heard as favorable tale from some sources or other, almost any day in the past, is, that the amount of work in contemplation is pronounced by several authorities to be considerable. The New York representative of one of the older Western concerns, who does not cater to the office building trade, but finds his customers in industrial circles, reports that he is making more proposals to install engines than last year. A certain high-speed engine company state, to like effect, that they have inquiries enough, and for power purposes, not merely for electric lighting. So we see what an amount of business would like to be transacted if it only dared and could afford to be.

For those of the trade who depend upon local office buildings prospects are comparatively good, because of the number of plans filed this season and the evidences of preparation for future sky-scrapers, obvious to a passer along Broadway.

Little is doing among the pump companies. Some marine work is said to be in sight.

NOTABLE RECENT BUSINESS.

The New York Sugar Refining Company, Long Island City, has contracted for 1,600 horse-power of Greene engines. A contract has been let, to install Ideal

engines in Wanamaker's store, Philadelphia. The total horse-power of these in the building when all are put in will be about 1,500 horse-power. An order for 400 kilo-watts of dynamos and engines to run them is expected to be placed, within a few days, for Carnegie Hall, of this city. The Waclark Wire Works, Elizabethport, N. J., have bought a 1,200 horse-power Harrison feed water heater, and the Edison Electric Illuminating Works, Brooklyn, N. Y., three large steam separators of the same make to carry 200 pounds pressure. Five hundred horse-power of Russell horizontal water tube boilers have been purchased for an industrial establishment in Brooklyn.

A contract for a boiler for mines in Ecuador is also expected by the Harrison Safety Boiler Works, Philadelphia. The boiler will have to be carried on mule back over a route so rugged that it must be divided into packages of not more than 80 pounds each, whereas the ordinary mule load is 150 pounds. The company has received an order for a small boiler to go to Colombia, for plantation purposes, which is also to be carried on mule back. In the latter case, however, the same obstacles to transportation are not encountered.

The Weston Engine Company, Painted Post, N. Y., are reported by a travelling man as being one of the busiest of the engine builders, at present, and although they may not have the amount of work on hand which might be expected in prosperous days, there is more of it than some time ago, and they have undertaken to double the capacity of their machine shop. The orders have been, to a prominent degree, Western ones.

The New York representative of a Pennsylvania concern reports good sales of boilers during May.

A REPORT ON MACHINE TOOLS.

From the Pratt & Whitney Co., Hartford, Conn., we learn that they have four men in Europe besides local agencies in Great Britain, France, Germany, Belgium and Russia. They intend soon to send a special agent to China and Japan also. They find the prospect for foreign business very fair at present, while domestic trade remains unsatisfactory.

WOOD-WORKING MACHINERY.

This market is pretty quiet. Certain topics of interest in connection therewith may be set forth by quoting some remarks recently made by a gentleman who represents, in this city, a company located in a neighboring State: " I am more of opinion than I was at first, that the combination of wood-working machinery manufacturers will prove a reality. The companies are losing money so fast that it is a necessity, for the purpose of self-preservation, that something be done. Prices are fearfully low. Why, only the other day, an order amounting to $2,800 was given out, and I believe that the amount of time and money expended before it was awarded, by the various parties trying to get hold of it, was as great as that sum. It appears that the consolidators are securing a still larger number of options, and people who at first scouted the idea are talking of it more leniently; in fact, one would not be surprised if they should make terms with it themselves.

"As to the strikes of the New York union wood-working men, the matter, as I understand it, is as follows: For some three years past the union woodworkers have been rebelling against the bringing of lumber already worked up from non-union mills outside of this city. About a year ago they gave notice that after the first of May, 1897, no more of it should be done. Subsequently they have allowed until October 1st, next, for the completion of old contracts, but no new ones with non-union mills outside of Greater New York are to be made. My personal opinion is that the matter will be successful, for it seems to be to the interest of all parties in the city who are connected with it. Something needs to be done, certainly, for sashes, doors, etc., already worked up can be brought into town at a lower price than can the rough lumber of which to make them. [It seems as if there must be a mistake here; yet affairs are in such a state that we are half inclined to think that there is none.]

"The effect of a success in this movement upon wood-working machinery would be an increased sale in this locality, offset by a diminished sale outside; so the net result would not be very important to the manufacturers thereof."

Naturally, however, the local demand for wood-working machinery would not suddenly be much increased if the boycott by the wood-workers were to effect its object; for the mills around here have already more machinery than they know what to do with. It need hardly be said that there is a great assortment of second-hand tools on the market, although one party who has recently had opportunity to observe the facts in regard to this, informs us that there is less good second-hand machinery for sale than he supposed, and that it is chiefly of the lighter order.

PITTSBURG REPORT FOR MAY.

The situation in this district materially improved during May, both in raw and finished lines. In the raw-iron market, production has kept up very well, the furnaces averaging about 275 tons daily. It takes the entire output of all the furnaces in Allegheny County to supply the demands of the mills and foundries in this vicinity at this time, and if business was only what it should be, iron would have to be secured from other points. There is an enormous amount of iron now being used in the different rolling-mill machinery plants. The Leechburg Foundry & Machine Company has lately contracted to furnish a large amount of rolls, shears, etc., while the outlook for future work is said to be quite promising.

Arrangements have just been completed for the erection of a tin plate mill, near Charleroi, Pa., for which an unusually large amount of new machinery of the latest improved type will be needed. So far, only the contracts for the erection of the buildings, boilers and engines, have been awarded. The E. P. Allis Company, of Milwaukee, Wis., was successful in securing the contract for the engines, which are to be of immense size. Quite a lot of competition has sprung up among the mill-machinery builders for the securing of the mill equipment, and prices will no doubt be cut to the last cent in order to secure the order. The policy of price-cutting has been in force for a long time.

Another large order recently placed was that of the engines for the new bar mill, which the Shenango Valley Iron Company, of New Castle, Pa., is building. This was secured by the Bass Foundry & Machine Works, of Fort Wayne, Ind.

It is remarkable what a large amount of second-hand machinery is being sold. In one sense it is advantageous to the seller, as it brings a good profit; but, on the other hand, machinery of new design is somewhat hindered. Dealers in general mill supplies are waiting for their season to open fully. This is expected to occur about July 1st, when mills generally close down for a period of repair time. Many mills are pretty well run down in their

(Continued on page 37.)

▲ ▲ ▲

Business Specials.

Gear wheels, gear cutting. Grant; see page 16.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Ct.

Engine Castings ⅛ to 2 H. P. Finished boilers and engines. Grant Sipp, Paterson, N. J.

"Modern Steam Engine Construction," parts 1 to 10; 30 cents each. T. F. Scheffler, Erie, Pa.

Send $1 to the Tabor Mfg. Co., Elizabeth, N. J., for improved stop-motion revolution counter.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Cost of Manufacturing—Experienced manager will establish system of costs, giving exact account of every detail. Charge based on saving effected. Correspondence solicited. Geo. C. Thomas, 99 Nassau Street, New York. Room 212.

▲ ▲ ▲

Wants.

Situations and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday Morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Situations Wanted.

By exp. draftsman and M. E. Box 32, Am. Mach.

Mech. draftsman, 3½ yrs. office, 4 yrs. shop, auto. and general mchy., wants pos. Box 34, Am. Mach.

Engraver on steel and brass, especially on letters for typewriters and typefound's. Box 44, Am. Mach.

A good mech. draftsman seeks position; 12 yrs. experience, shop and office. Box 42, Amer. Mach.

Experienced pattern maker wants work; good references. Address Box 45, American Machinist.

Perm. pos. wanted by mech. draftsman; excellent ref. H. A. H., 2019 Pemberton St., Philadelphia, Pa.

A strictly first-class draftsman and designer open for engagement. Hydraulic and general machinery. A1 references. Box 41, AMERICAN MACHINIST.

Position wanted by toolmaker familiar with type writer, bicycle, experimental work; understands rapid production of parts; also to keep cost down. Box 37, AMERICAN MACHINIST.

Wanted—Position by a young German, with theoretical as well as practical education, as machinist or designer. Good chance to work up preferred to high wages. Box 43, AMERICAN MACHINIST.

Responsible position wanted by an experienced machinist and draftsman, foremanship preferred; have held positions as general foreman for years. Can give best of references. Box 40, AMER. MACH.

Situation wanted by young man; 5 years experience as all-r und machinist and 3 years in drawing office; would like to be with a reliable firm and gain more experience. Box 35, AMER. MACHINIST.

A party with a number of years' exp. in mfg. companies desires a situation as assistant to some mfg. co. Details and management of help pref. Ref. furn. Ad. M. W. C., P. O. Box 1829, Boston, Mass.

A successful mechanical superintendent is open to an engagement; familiar with brass and iron work, interchangeable work, tools, gauges, etc., general machinery and tools, and up-to-date shop and office management. Box 39, AMERICAN MACHINIST.

Expoit—Educated mech. and drafts., 39, speaks English, French, German, Spanish, would travel Europe for cycle and other machinery, tools, japans and sundries; 20 years in business, 10 in Europe. Box 17, AMERICAN MACHINIST.

Help Wanted.

Wanted—A rod mill man experienced on rolling copper and steel. Apply to P. O. Box 827, Providence, R. I.

Wanted—First-class man for crank lathe, also planer; permanent and desirable places for really good men. Box 25 AMERICAN MACHINIST.

▲ ▲ ▲

Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d h'd lathes & planers. S.M.York, Clev'd, O

Calipers & Gauges. F.A.Welles, Milwaukee, Wis

The Dutton Wet Twist Drill-Grinder is sold by the Garvin Machine Co., New York City.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co., Springfield, Mass.

Will sell at low figure patent No. 569717 Lubricator Pump. Fr. Kaufhold, Merseburg a/S. Germany.

Models, experimental and small special machy built. Write to Crocker & Lawson, Binghamton, N.Y.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Boye, Cincinnati, O

We make a specialty of Shartle's patent safety set collars. Prices low and samples free. Middletown Machine Co., Middletown, Ohio.

Wanted—Inventors before applying for a patent get "How to Apply for a Patent," $1. Sample pages free. Henry F. Noyes, 56 Liberty Street, N. Y.

Wanted to manufacture in the South on royalty gasoline engines; one that has passed the experimental stage; give des. Address Box 38, AM. MACH.

For Sale—Modern machine shop and foundry in one of the largest cities on the lakes; equipment new and complete; dock and rail facilities; good business; good reasons for selling. Address Box 36, care AMERICAN MACHINIST

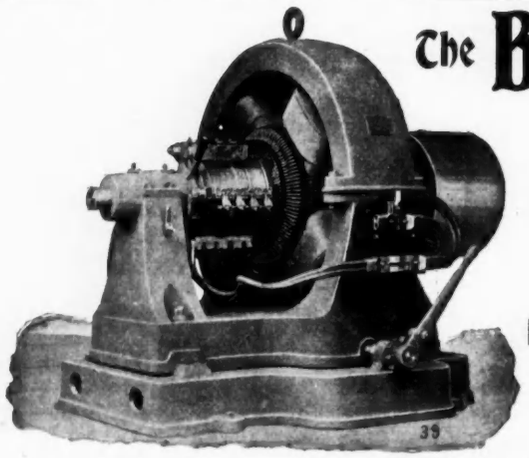
Wanted—An Idea. Who can think of some simple thing to patent? Protect your ideas; they may bring you wealth. Write John Wedderburn & Co., Patent Attorneys, Washington, D. C., for their $1,800 prize offered to inventors.

A machine shop, with modern equipment, heavy and light machinery, cranes of 20 tons capacity and 10,000 square feet of unoccupied floor space, would contract to manufacture any kind of machinery. Parties already having machinery built under contract might do well to write us for estimates. Box 62, AMERICAN MACHINIST.

MARK YOUR TOOLS WITH A STEEL STAMP

F. A. SACKMANN. 34 PROSPECT ST. CLEVELAND, OHIO. OHIO

SEND FOR PRICE LIST No. 4.



The Bullock Electric Mfg. Co.

CINCINNATI, O.

▲ ▲ ▲

Direct Connected and Belted Generators and Motors.

DIRECT CONNECTED MOTORS FOR

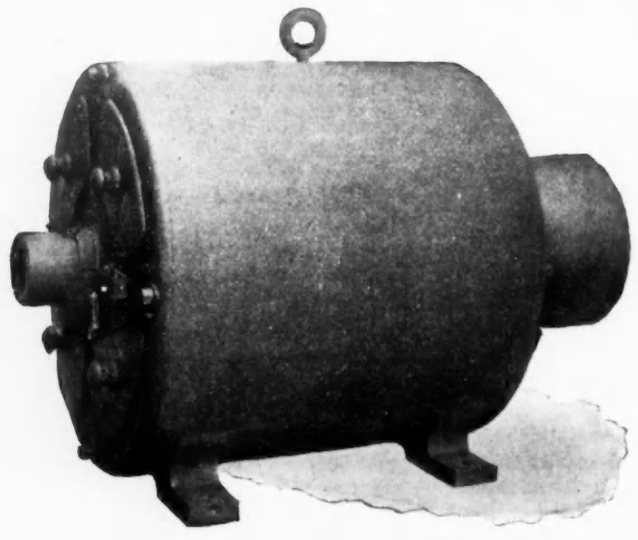
Line Shafts, Machine Tools, Punching Presses, Ceiling Motors.

▲ ▲ ▲

Sales Agents, Bullock Electric Company,

NEW YORK, St. Paul Building. BOSTON, 8 Oliver Street. PHILADELPHIA, Bourse Building.

CHICAGO, Bullock Elec. Mfg. Co., Western Union Building. ST. LOUIS, St. Louis Elec. Supply Co., 911 Market St.
LOUISVILLE, Wood & Speed, 235 Fifth St. DENVER, T. H. Smith, 1724 Champa St.
LONDON, ENG., Bergtheil & Young, No. 12 Camomile St.



An

Iron Clad Motor

Having all parts enclosed and unequaled adaptabilities for all classes of factory work. Absolutely dust and dirt proof.

The C. & C. Electric Co.,

143 Liberty St., New York.

Branch Offices: 63 Oliver Street, BOSTON, MASS. 633 Arch Street, PHILADELPHIA, PA. 630 Equitable Building, ATLANTA, GA.

ENGINES, STEAM.

Ames Iron Works, Oswego, N. Y.
Forbes & Co., W. D., Hoboken, N. J.
Frick Co., The, Waynesboro, Pa.
Toomey, Frank, Philadelphia, Pa.

FEED WATER HEATERS AND PURIFIERS.

Taunton Locomotive Mfg. Co., Taunton, Mass

FITTINGS, PIPE.

Kelly & Jones Co., New York.
Tight Joint Co., New York.

FOREIGN EXCHANGE.

Brown Bros. & Co., New York.

FORGES.

Buffalo Forge Co., Buffalo, N. Y.

FORGINGS, HYDRAULIC.

Wyman & Gordon, Worcester, Mass.

FRICTION CONES.

Evans Friction Cone Co., Boston, Mass.

FURNACES, GAS.

American Gas Furnace Co., New York.

GAGES.

Brown & Sharpe Mfg. Co., Providence, R. I.
Rogers' John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Wyke & Co., J., East Boston, Mass.

GEAR CUTTERS.

Brainard Milling Machine Co., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Gould & Eberhardt, Newark, N. J.
Hill, Clarke & Co., Boston, Mass.
Starrett Co., L. S., Athol, Mass.

GEAR CUTTER-CUTTER GRINDERS

Gould & Eberhardt, Newark, N. J.

GEAR CUTTING MACHINES.

Brown & Sharpe Mfg. Co., Providence, R. I.

GEARS.

Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Grant Gear Works, Boston Mass.
New Process Raw Hide Co., Syracuse, N. Y.
Shriver & Co., T., New York.

GRAPHITE, LUBRICATING.

Dixon Crucible Co., Joseph, Jersey City, N. J.

GRINDING AND POLISHING MACHINES.

Builders Iron Foundry, Providence, R. I.
Diamond Machine Co., Providence, R. I.
Hill, Clarke & Co., Boston, Mass
Webster & Perks Tool Co., Springfield, O.

GRINDERS, CENTER.

Barker & Co., William, Cincinnati, O.

GRINDING MACHINE, CUTTER.

Cincinnati Milling Machine Co., Cincinnati, O.
Foote, Barker & Co., Cleveland, O.

GRINDING MACHINE, UNIVERSAL.

Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.

GRINDSTONES.

Cleveland Stone Co., Cleveland, O.

HACK SAWS.

Q. & C Co., Chicago, Ill.

HAMMERS.

Bliss Co., E. W., Brooklyn, N. Y.
Hill, Clarke & Co., Boston, Mass.

INDEX CENTERS.

Cincinnati Milling Machine Co., Cincinnati, O.

INJECTORS.

Hayden & Derby Mfg. Co., New York.

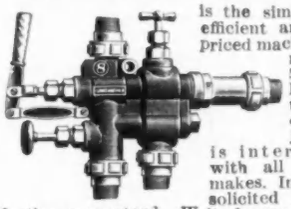
INVENTIONS PERFECTED.

George L. Roby, Albany, Ind.

JACKS, HYDRAULIC.

Watson-Stillman Co., New York.

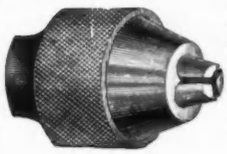
LUNKENHFIMER'S
AUTOMATIC SINGLE TUBE INJECTOR.



is the simplest, most efficient and lowest priced machine on the market. Has 50 per cent. less parts than any other Injector and is interchangeable with all standard makes. Investigation solicited and satisfaction guaranteed. Write for special circular and prices.

THE LUNKENHEIMER COMPANY,
CINCINNATI, OHIO, U.S.A.
SOLE MANUFACTURERS.
BRANCHES: 108 Havemeyer Bldg., New York. 35 Great Dover St., London, S. E.

McFADDEN COMPANY.
TAPS & DIES · VISES · CHUCKS · DRILLS · TWIST · MACHINE · SCREWS · LATHES · FILES · STEEL · TOOLS · STUBS
TOOLS
No. 722 Arch St., PHILADELPHIA, PA.



ALMOND
DRILL CHUCK.
Sold at all Machinists' Supply Stores.
T. R. ALMOND,
83 & 85 Washington St.,
BROOKLYN, N. Y.

HENRY CAREY BAIRD & CO.,
Industrial Publishers, Booksellers and Importers
810 Walnut Street, PHILADELPHIA.
Our New and Revised Catalogue of Practical and Scientific Books, 88 pages, 8vo, and our other Catalogues and Circulars, the whole covering every branch of Science applied to the Arts, sent free and free of postage to any one in any part of the world who will furnish his address.

EXTRA HEAVY ROUGH
BRASS UNIONS.
BRASS AND PHOSPHOR BRONZE CASTINGS for all purposes.
Special Finished Brass Work to Order.
NOLTE BRASS CO.
68 and 70 E. Washington St.
SPRINGFIELD, O.

COMBINED DRILL AND COUNTERSINK
FOR CENTERING LATHE WORK.

J. T. SLOCOMB & CO.,
PROVIDENCE, R.I. U.S.A.

Bullock
Electric Mfg.
Co.

KEYWAY CUTTERS.

Baker Bros., Toledo, O.
Mitts & Merrill, Saginaw, Mich.

LATHES (see also Turret Lathes).

Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., Philadelphia, Pa.
Blaisdell & Co., P., Worcester, Mass.
Bradford Mill Co., The, Cincinnati, O.
Bullard Machine Tool Co., Bridgeport, Conn.
Dietz, Schumacher & Boye, Cincinnati, O.
Fifield Tool Co., Lowell, Mass.
Fitchburg Machine Works, Fitchburg, Mass.
Flather & Co., Nashua, N. H.
Hamilton Machine Tool Co., Hamilton, O.
Hendey Machine Co., Torrington, Conn.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mach. Co., Springfield, Vt.
Le Blond, R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., Hamilton, O.
Niles Tool Works Co., New York.
Ober Lathe Co., Chagrin Falls, O.
Oliver, W. W., Buffalo, N. Y.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Reed Co., F. E., Worcester, Mass.
Sebastian Lathe Co., Cincinnati, O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Warner & Swasey, Cleveland, O.

LUBRICATORS.

Kelly & Jones Co., New York.
Lunkenheimer Co., Cincinnati, O.

MACHINE TOOLS.

Brown & Sharpe Mfg. Co., Providence, R. I.
Fitchburg Machine Works, Fitchburg, Mass.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Whitney Mfg. Co., Hartford, Conn.

MACHINISTS' TOOLS AND SUPPLIES.

Besly & Co., Chas. H., Chicago, Ill.

MILLING CUTTERS.

Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Eriandsen, J., New York.
Ingersoll Milling Machine Co., Rockford, Ill.
Keinecker, J. E., Chemnitz-Gablenz, Germany.
Starrett Co., L. S., Athol, Mass.

MILLING MACHINES.

Adams Co., Dubuque, Ia.
Becker Milling Machine Co., Fitchburg, Mass.
Brainard Milling Machine Co., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Clough R. M., New Haven, Conn.
Forbes & Co., W. D., Hoboken, N. J.
Garvin Machine Co., New York.
Hill, Clarke & Co., Boston, Mass.
Ingersoll Milling Machine Co., Rockford, Ill.
Kempsmith Mch. Tool Co., Milwaukee, Wis.
Mergenthaler & Co., Ott., Baltimore, Md
Mossberg & Granville Mfg. Co., Providence, R. I.
Reed Co., F. E., Worcester, Mass.

MOLDING MACHINES.

Tabor Mfg. Co., Elizabeth, N. J.

MOTORS, ELECTRIC.

Crocker-Wheeler Electric Co., New York.
C. & C. Electric Co., New York.
Pallett & Co., Thos. H., Philadelphia, Pa.

MUFFLER VALVES.

Consolidated Safety Valve Co., New York.

OIL CUPS.

Lunkenheimer Co., Cincinnati, O.

PACKING.

Peerless Rubber Mfg. Co., New York.

PAINT.

Jos. Dixon Crucible Co., Jersey City, N. J.

PATENT ATTORNEYS.

Dodge, Phil. T., Washington, D. C.
Dyer & Driscoll, New York.
Thompson, Edw. P., New York.
Wedderburn & Co., John, Washington, D. C.

PATTERN MAKERS' MACHINERY.

Baker Bros., Toledo, O.
Whitney, Baxter D., Winchendon, Mass.

PENCILS.
Jos. Dixon Crucible Co., Jersey City, N. J.

PERFORATED METALS.
Harrington & King Perforating Co., The Chicago, Ill

PHOSPHOR BRONZE.
Phosphor Bronze Smelting Co., Ltd., Philadelphia, Pa.

PIPE CUTTING AND THREADING MACHINES.
Armstrong Mfg. Co., Bridgeport, Conn.
Curtis & Curtis, Bridgeport, Conn.
Saunders' Sons, D., Yonkers, N. Y.

PIPE, WROUGHT.
National Tube Works, McKeesport, Pa.

PLANERS.
Bement, Miles & Co., Philadelphia, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Flather & Co., Nashua, N. H.
Gray Co., G. A., Cincinnati, O.
Hendey Machine Co., Torrington, Conn.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York
Niles Tool Works Co., Hamilton, O.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whitcomb Mfg. Co., Worcester, Mass.

PRESSES, DIES, ETC.
Bliss Co., E. W., Brooklyn, N. Y.
Mossberg & Granville Mfg. Co., Providence, R. I.
Stiles & Fladd Press Co., Watertown, N. Y.
Toledo Machine & Tool Co., The, Toledo, O.

PRESSES, HYDRAULIC.
Watson & Stillman Co., New York.

PROTRACTORS.
Coffin & Leighton, Syracuse, N. Y.

PULLEY BLOCKS.
Gebr. Bolzani, Berlin, Germany.

PUNCHES AND SHEARS.
Long & Allstatter Co., Hamilton, O.
New Doty Mfg. Co., Janesville, Wis.

RACK CUTTING ATTACHMENT.
Cincinnati Milling Mach. Co., Cincinnati, O.

RAW HIDE.
New Process Raw Hide Co., Syracuse, N. Y.
Shultz Belting Co., St. Louis, Mo.

REAMERS.
Mergenthaler & Co., Ott., Baltimore, Md.
Morse Twist Drill & Mch. Co., New Bedford, Mass.

ROLLER BEARINGS.
Mossberg & Granville Mfg. Co., Providence, R. I.
Hyatt Roller Bearing Co., Newark, N. J.

ROLLING MILLS.
Mossberg & Granville Mfg. Co., Providence, R. I.

RUBBER GOODS.
Peerless Rubber Mfg. Co., New York.

RULES.
Brown & Sharpe Mfg. Co., Providence, R. I.
Coffin & Leighton, Syracuse, N. Y.

SAFETY VALVES POP.
Consolidated Safety Valve Co., New York.
Crosby Steam Gage & Valve Co., Boston, Mass.

SAWS, HACK.
Q. & C. Co., Chicago, Ill.

SAWING MACHINES, METAL.
Q. & C. Co., Chicago, Ill.

SCHOOLS.
Columbia University, New York.
International Correspondence Schools, Scranton, Pa.
Purdue University, La Fayette, Ind.
Rose Poly. Institute, Terre Haute, Ind.

SCREENS, PERFORATED METAL.
Harrington & King Perf. Co., Chicago, Ill.

SCREW MACHINES (see Turret Lathes).

SCREWS, MACHINE.
Cincinnati Screw and Tap Co., Cincinnati, O.
Worcester Machine Screw Co., Worcester, Mass.

Columbia University
in the City of New York.

SCHOOL OF MINES,
SCHOOL OF CHEMISTRY,
SCHOOL OF ENGINEERING,
SCHOOL OF ARCHITECTURE,
SCHOOL OF PURE SCIENCE.

Four years' undergraduate courses and special facilities for graduate work in all departments. Circulars forwarded on application to the Secretary of the University.

PATENT OFFICE
ESTABLISHED IN 1883.
EDWARD P. THOMPSON,
Member American Institute Electrical Engineers. Served on Boards of Managers and Examiners. Member American Society Mechanical Engineers. Author "Inventing as a Science and an Art," and "Roentgen Rays, and Phenomena of the Anode and Cathode."

PROF. WM. A. ANTHONY,
For 15 years of Cornell University. Past President American Institute Electrical Engineers. Author with Prof. Brackett, of Princeton, of "Text Book of Physics."

ALFRED C. COURSEN,
Counselor at Law.

U. S and Foreign Patents, Patent Suits and Interferences, Agreements and Assignments, Trademarks and Designs, Opinions on Infringement, etc. Engineering Specifications. Expert Testimony, Tests, Reports, Opinions, Working Drawings, Examinations, etc.

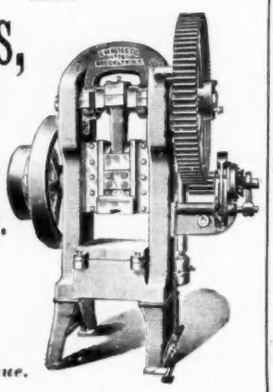
Address, **EDWARD P. THOMPSON,**
5 BEEKMAN ST., NEW YORK CITY.

RADIAL DRILLS

Wm. E. Gang & Co.
No. 1108 Harrison Ave.,
Cincinnati, Ohio, U.S.A.
Write for Circulars.

E. W. BLISS CO.
1 Adams St., Brooklyn, N.Y.
CHICAGO, 96 West Washington Street.

Presses,
DROP HAMMERS, DIES, SHEARS AND SPECIAL MACH'Y FOR Sheet Metal Work.
Bicycle and Electrical Tools.
Write for Catalogue.



OWNERS OF
THE STILES & PARKER PRESS CO.

SEPARATORS, OIL.
Springfield Separator Co., Springfield, Vt.

SHAPERS.
Bement, Miles & Co., Philadelphia, Pa.
Davis & Egan Machine Tool Co., The, Cincinnati, O
Flather & Co., Nashua, N. H.
Gould & Eberhardt, Newark, N. J.
Hendey Machine Co., Torrington, Conn.
Hill, Clark & Co., Boston, Mass.
McCabe, J. J., New York.
Morton Mfg. Co., Muskegon Heights, Mich.
Pratt & Whitney Co., Hartford, Conn
Prentiss Tool & Supply Co., New York.

SHEARS.
Bethlehem Fdy. & Machine Co., South Bethlehem, Pa.

STEAM BOILER INSURANCE.
Hartford Steam Boiler Ins. & Insp. Co., Hartford, Conn.

STEEL.
Crescent Steel Co., Pittsburg, Pa.
Jessop & Son., Wm., New York.
Jones & Co., B M., Boston, Mass.
Pittsburg Tool Steel Co., Pittsburg, Pa.
Pratt & Inman, Worcester, Mass.

TAPPING ATTACHMENT.
Errington, F. A., New York.
Union Tire Co., Plainfield, N J.

TAPPING MACHINERY.
Garvin Machine Co., New York.
National Machinery Co., Tiffin, O.

TAPS AND DIES.
McFadden Co., Philadelphia, Pa.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. & Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

TOOL CATALOGUE.
Strelinger & Co., Chas. A., Detroit, Mich.

TOOL GRINDERS.
Gisholt Machine Co. Madison, Wis.

TOOL HOLDERS.
Armstrong Bros. Tool Co., Chicago, Ill.
Gould & Eberhardt, Newark, N. J.

TOOLS, MECHANICAL, FINE.
Brown & Sharpe Mfg. Co., Providence, R. I.
Standard Tool Co., Athol, Mass.
Sawyer Tool Co., Athol, Mass.
Starrett Co., L. S., Athol, Mass.

TURRET LATHES (Screw Machines).
Bardons & Oliver, Cleveland, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Machine Tool Co., Bridgeport, Conn.
Cleveland Machine Screw Co., Cleveland, O.
Dreses, Mueller & Co., Cincinnati, O.
Flather & Co., Nashua, N. H.
Garvin Machine Co., New York.
Gisholt Machine Co., Madison, Wis.
Jones & Lamson Machine Co., Springfield, Vt.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
Pearson Machine Co., Chicago, Ill.
Warner & Swasey, Cleveland, O.

VALVES.
Consolidated Safety Valve Co., New York.
Jenkins Bros., New York.
Kelly & Jones Co., New York.

VENTILATORS.
Pancoast Ventilator Co., Philadelphia, Pa.

WATER MOTORS.
Backus Water Motor Co., Newark, N. J.

WIRE MACHINERY.
Goodyear, S. W., Waterbury, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.

WOODWORKING MACHINERY.
Bentel & Margedant Co., The, Hamilton, O.
J. A. Fay & Egan Co., Cincinnati, O.
Whitney, Baxter D., Winchendon, Mass.

WORM GEARS.
Albro-Clem Elevator Co., Philadelphia, Pa.
Morse, Williams & Co., Philadelphia, Pa.

Prentice Bros. Lathes and Drilling Mchy.

WORCESTER, MASS., U. S. A.

ORIGINAL DESIGNS. LATEST IMPROVEMENTS. HIGH-GRADE TOOLS.

WRITE NOW FOR NEW CATALOGUE "P" OR PHOTOS, FREE.

A man is known by the tools he uses. Associate with Morse Tools.

Red Book for Ready Reference contains all you want to know.

Morse Twist Drill and Machine Company, New Bedford, Mass., U. S. A.

WE BUILD MILLING MACHINES possessing all the desirable features of Range, Strength, . . . Convenience and Durability. . . . . .

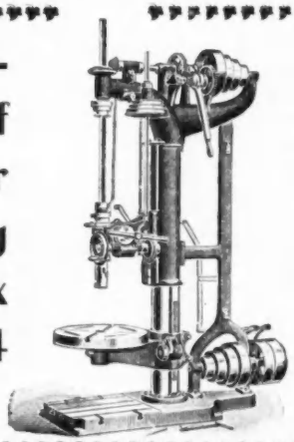
Agents: J. J. McCABE, New York, THE FAIRBANKS CO., Philadelphia, Pa.

Kempsmith Machine Tool Co.

MILWAUKEE, WIS., U. S. A.

THE STRONG, CARLISLE & TURNEY CO., Cleveland, O. SELIG, SONNENTHAL & CO., London, Eng.

THIS Drill is the Result of Years of Study and Work in our Special Line—Drilling Machines. Built in six sizes from 24 to 44 inches swing.



This space won't let us tell you about this Drill at length, the Patent Quick Return, the back-gear arrangement, the automatic stop, etc. Let us send you our drill book—we are drill specialists—there's Pointers in it. We build smaller drills too—from 12 in. to 21 in.

Hamilton Machine Tool Co.

20 to 32 Zimmerman Ave.,

Hamilton, Ohio, U. S. A.

WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY,

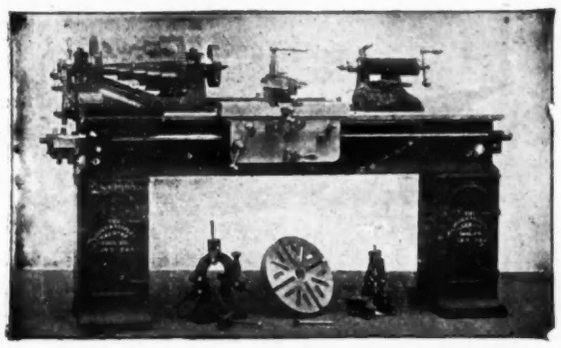
PITTSBURG, PA.

We make the Most Complete Electric Equipments for Factories, Mills and Machine Shops.

NEW YORK, 120 Broadway.
BOSTON, Exchange Building.
BUFFALO, No. 8, Erie County Bank Building.
CHARLOTTE, N. C., 36-38 College Street.
CHICAGO, New York Life Building.
PHILADELPHIA, Girard Building.
PITTSBURG, Westinghouse Building.
ST. LOUIS, American Central Building.
SAN FRANCISCO, Mills Building.
SYRACUSE, N. Y., Bastable Building.
TACOMA, WASH., 102 South Tenth Street.

WESTINGHOUSE ELECTRIC COMPANY, Ltd., 32 Victoria Street, London, S. W., England.

For CANADA address: Ahearn and Soper, OTTAWA, CANADA.



We Make the Bold Statement

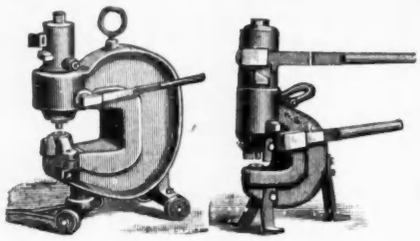
That our 14 in. and 16 in. Lathes are UNEXCELLED. We erect FIFTY Lathes, including beds, at ONE TIME. We have fifty on the floor now finishing. We assert that they are capable of MORE WORK, have greater RANGE POWER and CAPACITY, for doing a varied character of work, within a given time, than ANY LATHE offered. We guarantee their TRUTH, ACCURACY and GOOD WORKMANSHIP. We can make INSTANT SHIPMENT of TWENTY-FIVE Lathes, if necessary.

THE LODGE & SHIPLEY MACHINE TOOL COMPANY,

CINCINNATI, OHIO, U. S. A.

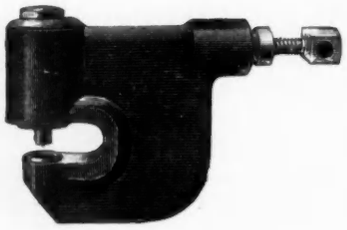
SCHISCHKAR & CO., Birmingham, England, Agents for Great Britain. MARKT & CO., Ltd., Hamburg, Berlin and Paris, Agents for Europe.

We Make Boring Machines, Milling Machines, Special Tools Beaman & Smith PROVIDENCE, R. I.



Hydraulic Punches

of every size, shape, power, and for every conceivable purpose. These pictures only show a few of those we build.

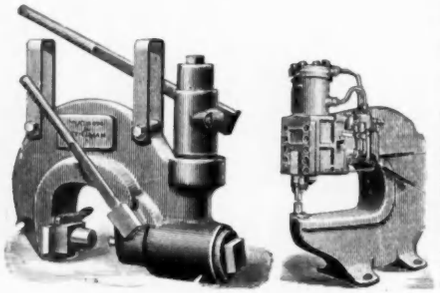


Ask for Catalog of the

Watson-Stillman Company,

202 East 43d Street, New York.

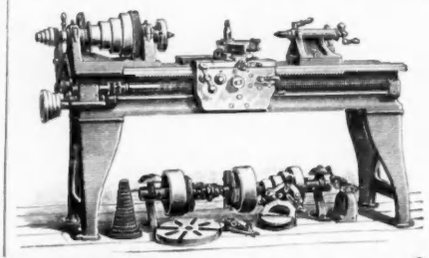
"Jackmakers to the Universe."



Drop Hammers, Presses, Special Mach'y Dies,

THE STILES & FLADD PRESS CO.,

WATERTOWN, N. Y.



DIETZ, SCHUMACHER & BOYE,

MANUFACTURERS OF

LATEST IMPROVED ENGINE LATHES,

CINCINNATI, OHIO.

THIS CUT SHOWS 14 INCH LATHE.

BECKER MILLER

No. 3

EVERY SHOP needs one for the odd jobs constantly coming along. It is

SO HANDY.

For DIE SINKERS

We build this machine with foot lever, instead of the hand wheel, for the head adjustment, with or without automatic feeds.

Write for list of Users of No. 3 Becker Millers.

FOREIGN AGENTS:

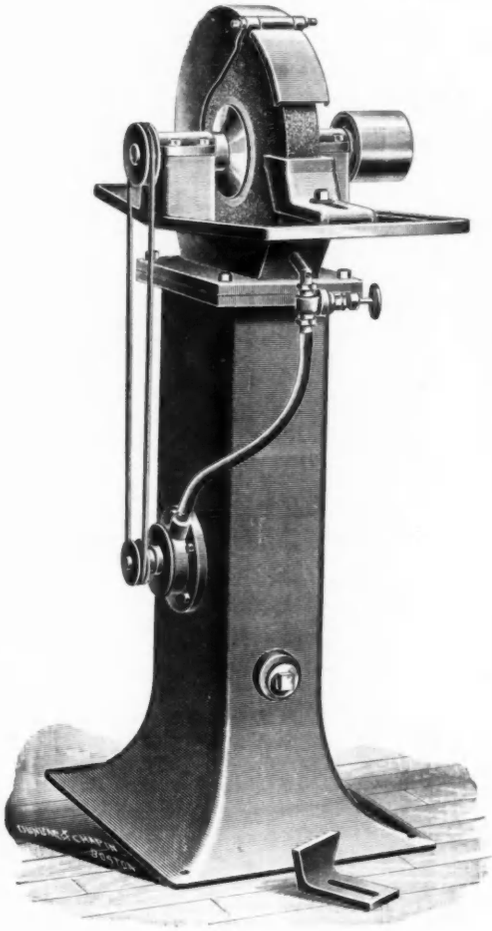
SCHUCHARDT & SCHÜTTE, Berlin.

CHAS. CHURCHILL & CO., London.

Becker Milling Machine Co.

FITCHBURG, MASS.

Tool Grinder.



If you have a small machine shop, you ought to have one of our TOOL GRINDERS; if you have a large shop, you should have several of them.

They cost but little and are all right.

Size of Emery Wheel, 14″ x 2″.

Write for descriptive circular.

Hill, Clarke & Co.

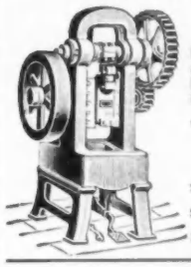
156 Oliver Street, Boston, Mass., U.S.A.

14 So. Canal St., Chicago, Ill.

GOOD engravings for good people made by the American Machinist are somewhat better than most others, and it might be dollars in your clothes to find out something about it. One of the best times to start a correspondence is right now.

American Machinist, 256 Broadway, New York City.

The Toledo Machine & Tool Co.



Toledo, Ohio, U. S. A.

MANUFACTURERS OF

Power Punching, Drop, Trimming, Stamping, Riveting and Embossing Presses for working Bar and Sheet Metals.

COMPLETE OUTFITS FOR BICYCLE STAMPINGS, CAN MAKING, ETC.

Send for 1897 Catalogue, just out.

Sole European Agents—SELIG, SONNENTHAL & Co., London.
Sole Agent in Germany—E. SONNENTHAL Jr., Berlin, Neue Promenade 5.
Pacific Coast Agent—V. J. A. REY, San Francisco Cal.

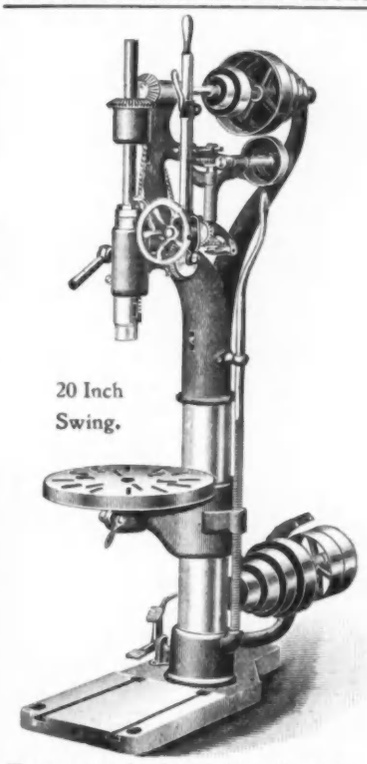
ELECTRIC LIGHT ENGINES.

Photos, Description and Estimates for the asking.

W. D. FORBES & CO.,

HOBOKEN, N. J.

1302 Hudson St., 2 blocks from 14th St. Ferry.



20 Inch Swing.

We are prepared to furnish this Drill with Round or Square Slotted Tables, Lever Feed, Hand Worm Feed, Power Self-Feed, Automatic Stop and Quick Return.

All above Feeds are Combined or Single.

EQUIPPED WITH

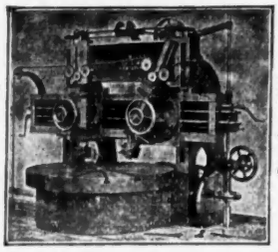
PLAIN FRICTION or QUARTER-TURN COUNTERSHAFT

Send for Catalogue.

W. F. & JOHN BARNES COMPANY,

1995 Ruby Street, ROCKFORD, ILL.

CHAS. CHURCHILL & CO., English Agents, LONDON, E. C.


60-Inch Boring and Turning Mill.

The Best of the Labor Saving Tools.

Boring and Turning Mills,

From 30 Inches to 30 Feet Swing.

Correspondence Solicited.

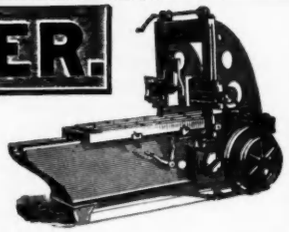
Branches:
NEW YORK, CHICAGO, BOSTON, PHILADELPHIA, PITTSBURG.

English Branch, 39 Victoria St., London, S.W.

THE NILES TOOL WORKS COMPANY,

Main Office and Works, HAMILTON, OHIO.

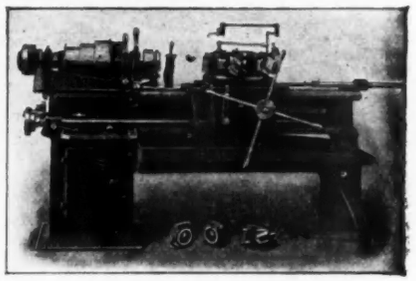
THE GRAY PLANER.



THE G. A. GRAY CO., CINCINNATI, O.

These Machines are sold by the following Agents:

HILL, CLARKE & CO., 14 South Canal St., Chicago, Ill.
STRONG, CARLISLE & TURNEY CO., 193 Bank St., Cleveland, O.
E. A. KINSEY & CO., 331 West Fourth St., Cincinnati, O.
THOS. K. CAREY & BROS. CO., 26 Light St., Baltimore, Md.
J. J. McCABE, 14 Dey St., New York City.
PACIFIC TOOL & SUPPLY CO., 102 First St., San Francisco, Cal.
SCHUCHARDT & SCHUTTE, Berlin, Vienna and Brussels.
CHAS. CHURCHILL & CO., Ltd., London and Birmingham, England.



The Flat Turret Lathe

Does Lathe work accurately up to 2 in. diameter by 24 in. long.

◆

Jones & Lamson Machine Co.

Springfield, Vt., U. S. A.

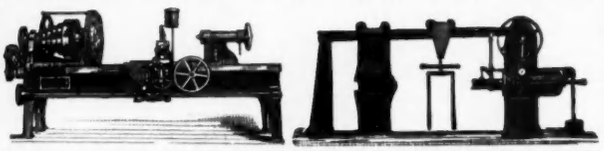
Representative for Germany, Switzerland, Austria-Hungary, Russia, Holland and Belgium: M. KOYEMANN, Charlottenstrasse, 118, Dusseldorf, Germany.

England: HENRY KELLEY & CO., 94 Pall Mall, Manchester.

William Sellers & Co. Incorp. PHILADELPHIA.

HAVE YOU EXAMINED?

THE NEW TOOL GRINDER, No. 2?
THE CENTRIFUGAL SAND MIXER?
THE VICARS' MECHANICAL STOKER?



POWERFUL GRIP. PERFECTLY TRUE.

Drill Chucks

WE GUARANTEE THEM. POSITIVELY DUST PROOF.

They are using these chucks on Turret Machines in preference to holders.

Carpenters and Millwrights are using them in their bit braces. We fit them with bit-brace shanks.

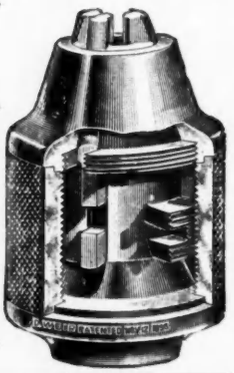
The jaws have double the length and bearing surface. For cutting or threading rod stock, a hole the full capacity of the chuck may be drilled through the entire center.

Let us send you a Catalogue.

◆

The Pratt & Weir Chuck Co.

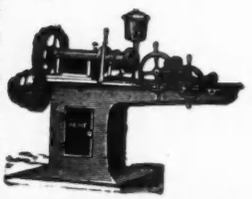
HARTFORD, CONN., U.S.A.



THE ACME Machinery Co.

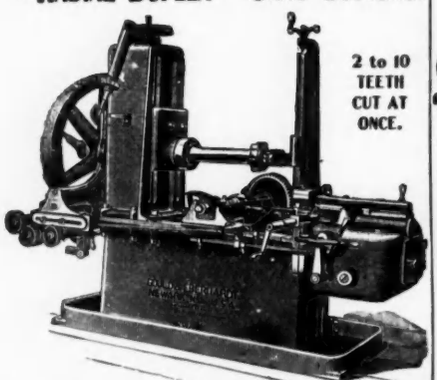
CLEVELAND, O.

MANUFACTURERS OF
ACME BOLT AND RIVET HEADERS,
ACME SINGLE AND DOUBLE AUTOMATIC BOLT CUTTERS, cutting from 1-8 in. to 6 in. diam.
ALSO SEPARATE HEADS AND DIES.



PATENT ENTIRELY AUTOMATIC

GEAR CUTTERS & "RADIAL DUPLEX" GANG CUTTERS.



2 to 10 TEETH CUT AT ONCE.

GOULD & EBERHARDT.

NEWARK, NEW JERSEY, U.S.A.

Foreign Agents:
JOHN LANG & SONS, Johnstone, Scotland.
SCHUCHARDT & SCHUTTE, Berlin, Vienna, Brussels.
G. KOEPPEN & Co., Moscow, Russia. Shaper Agents.
WHITE, CHILD & BENEY, Vienna, Aus. Shaper Agents.

EXPORT TRADE A SPECIALTY.

ST. LOUIS, MO.

SET AND CAP SCREWS

STUDS — **CINCINNATI SCREW & TAP Co.** — NUTS

STANDARD AND SPECIALS.

CINCINNATI, O., U.S.A.

FOR ENGINES AND MACHINERY.

CLAYTON AIR COMPRESSOR WORKS

SEND FOR CATALOGUE. 26 Cortlandt St. NEW YORK.

CRANES

PAWLING & HARNISCHFEGER,

163 Clinton Street, MILWAUKEE, WIS.

GRANT GEARS

GEAR WHEELS CUTTING

Grant Gear Works,
125 South 11th Street, PHILADELPHIA.
6 Portland Street, BOSTON.
96 Seneca Street, CLEVELAND.

Send for Catalog.

MANUFACTURERS OF

Twist Drills, Reamers and Taps

THE STANDARD TOOL CO.

CLEVELAND, OHIO.

Spring Cotters and Flat Spring Keys.